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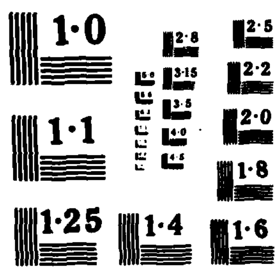

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US Army Corps
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AD-A160 791

Aloha-Rigolette Area, Louisiana

Agricultural Flood Control

Feasibility Study

Volume 2
Technical Appendixes
A, B, C, D, E
June 1985

ALOHA - RIGOLETTE AREA, LOUISIANA

FEASIBILITY STUDY

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Appendix A

FORMULATION, ASSESSMENT, AND EVALUATION OF DETAILED PLANS

A.0.1. Plan formulation is a dynamic process that systematically guides the formulation, evaluation, and assessment of plans through a series of decisions. Guidelines for the formulation and evaluation of plans of improvement for all Federal water and related land resources activities are contained in the Water Resources Council Principles and Guidelines for Planning Water and Related Land Resources, which were established pursuant to Section 103 of the Water Resources Planning Act, as amended (Public Law 89-80, amended by Public Law 94-112). The principles and guidelines prescribe a single Federal objective, national economic development (NED), consistent with protecting the nation's environment. In this study, an interdisciplinary planning team composed of an economist, biologist, planner, hydrologist, water quality specialist, and archeologist developed a full range of alternatives to balance both the environmental and developmental needs. This appendix describes the process followed in the study, the criteria used in the formulation and evaluation process, the results of evaluation and assessment, and the trade-off analysis leading to the selection of a plan. The three sections in this appendix are equivalent to the three phases followed in plan formulation. Sections 1, 2, and 3 describe preliminary, intermediate, and detailed plan formulation results. Section 4 discusses the division of plan responsibility for the tentatively selected plan and describes operation and maintenance responsibility.

SECTION 1. PRELIMINARY PLAN FORMULATION

A.1.1. Formulation of the initial plans was largely conceptual, as were the evaluations and assessments of those plans. The primary objective of the initial studies was to explore a wide range of alternatives and determine whether any plans warranted further study. The results of preliminary plan formulation studies were documented in the "Aloha-Rigolette Area, Louisiana, Reconnaissance Report" dated April 1981. The results of these studies are summarized in this section to provide a foundation for understanding the subsequent studies.

PROBLEM IDENTIFICATION

A.1.2. The major water resource problem in the Aloha-Rigolette area is agricultural flooding. The agricultural area represents 18 percent of the basin and is nearly surrounded by wooded hill lands that constitute the remainder of the basin. Runoff from the entire basin is funneled through the flat plain of the agricultural area into a control structure located at the southern end of the basin. Other water-related resources such as fish and wildlife, recreation, and water quality were investigated. Although no problem was identified, there appear to be opportunities to enhance these resources. Throughout the planning process, opportunities for water conservation were assessed.

PRELIMINARY PLANNING OBJECTIVES

A.1.3. Preliminary planning objectives were formulated on the basis of the water resources problems, needs, and opportunities, and concerns expressed by the public. The following planning objectives were developed:

- Reduce flood losses in the Aloha-Rigolette area to increase agricultural production.

- Stem the decline of and, where possible, enhance bottomland hardwoods located in the alluvial flood plain of the Aloha-Rigolette area.

- Protect and, where possible, enhance the fish and wildlife resources in the Aloha-Rigolette area.

- Protect and, where possible, enhance existing wetlands in the Aloha-Rigolette area.

- Improve the water quality of Bayou Rigolette and its tributaries within the alluvial flood plain.

- Improve water-oriented recreational opportunities in the Aloha-Rigolette area.

- Preserve and avoid contributing to the destruction of archeological and paleontological resources in the Aloha-Rigolette area.

A.1.4. As planning proceeded, the planning objectives were reanalyzed as the water resources problems, needs, and opportunities were refined.

PRELIMINARY MANAGEMENT MEASURES

A.1.5. To address the planning objectives, a list of resource management measures was developed. The measures identified included those suggested by the public and U.S. Fish and Wildlife Service. Both structural and nonstructural measures were included. Table A-1-1 lists the management measures considered in the preliminary phase of plan formulation.

A.1.6. The management measures were analyzed to determine their positive contribution to the planning objectives. The extent to which one measure met an objective over another was not measured at this stage.

TABLE A-1-1

MANAGEMENT MEASURES

1. Channel Enlargement	7. New Channels
2. Pumping Station(s)	8. Flood Plain Management
3. Floodgates(s)	9. Flood Retardation Structures
4. Reservoir(s)	10. Sediment Retention Basins
5. Modify Dam (Iatt Lake)	11. Clearing and Snagging
6. Flood Plain Acquisition	

PLAN FORMULATION RATIONALE

A.1.7. The Aloha-Rigolette area is subject to two types of flooding: headwater and backwater. Headwater flooding occurs when the rapid runoff from the hills and other areas exceeds the carrying capacity of the streams in the basin. Backwater flooding occurs when the Red River stages exceed Bayou Rigolette and the floodgates must be closed. With the floodgates closed, runoff from the basin cannot be discharged into the Red River and must be stored or ponded, thus causing flooding. Backwater flooding can also occur when basin runoff exceeds the discharge capacity of the existing floodgates. In addition to the different types of flooding, the following general facts on flooding were considered:

o Flooding is the primary water resource problem in the basin.

• The flood problem area is largely limited to the alluvial plain that is located along the southern border of the basin.

• The floodgates have been closed four times since the structure was completed in 1956.

Considering the above facts and the conditions concerning flooding in the basin, a number of concepts were identified for which plans could be formulated:

- Control a greater amount of the large runoff above Iatt Lake.

- Divert basin runoff to Red River upstream of the existing floodgate.

- Improve the efficiency of evacuating runoff at the site of the existing floodgate.

- Improve the capacity of bayous within the alluvial flood plain.

- Allow flooding to continue and acquire flooded lands.

A.1.8. Using these concepts, plans were formulated on the basis of perceived effectiveness. Structural and nonstructural plans were developed singly or in combination with each other with varying emphasis on the different economic, social, and environmental components in the planning objectives. The "no action" option was also presented and evaluated. The "no action" option provides a basis of comparing the with-project and without-project conditions.

PRELIMINARY PLANS

A.1.9. The conceptual alternative plans incorporated one or more of the management measures.

Plan 1 Control the large runoff above Iatt Lake by increasing the lake storage capacity. This would be accomplished by

raising the height of the dam and providing for controlled release.

Plan 2 Clear and snag Bayous Rigolette, Darrow, Marteau, Du Grappe, Sugarhouse, Caney, Saline, and Walden, the diversion channels constructed as part of the existing Aloha-Rigolette area project, and other bayous within the basin as determined necessary to increase the basin storage capacity.

Plan 3 Enlarge bayous identified in Plan 2 in lieu of clearing and snagging to provide even greater basin storage capacity than described in Plan 2.

Plan 4 Increase the storage capacity of Iatt Lake and provide for controlled release (Plan 1) and clear and snag bayous identified in Plan 2.

Plan 5 Increase the outlet capacity by providing additional floodgates at the site of the existing Bayou Rigolette structure.

Plan 6 Reopen the closure of Bayou Darrow at Red River and install floodgates to evacuate headwater before it reaches the lower basin area.

Plan 7 Reopen the closure of Bayou Darrow at Red River and install a pumping station at the junction of Bayou Darrow and the Red River Levee.

Plan 8 Improve the efficiency of major bayous identified in Plan 2 by clearing and snagging, and the outlet capacity by installing a pumping station near the existing Bayou Rigolette floodgate.

Plan 9 Install additional floodgates adjacent to the Bayou Rigolette floodgate instead of the pumping station in Plan 8.

Plan 10 Redirect most of the flow from Bayou Rigolette via Sam Bayou to a new channel extending to Red River and provide for a pumping station in the Red River levee two miles south of Colfax, Louisiana.

Plan 11 Provide a floodgate in the Red River levee two miles south of Colfax, Louisiana, instead of the pumping station in Plan 10.

Plan 12 Control the runoff from wooded upland areas by providing a series of upstream reservoirs serving as small flood-retarding structures.

Plan 13 Purchase lands frequently flooded in fee or title.

Plan 14 Purchase flowage easement over lands frequently flooded.

Plan 15 Institute a program that encourages erosion-controlling agricultural practices through structural or nonstructural measures (i.e., sediment retention basin).

Plan 16 Zone flood plain (e.g., agricultural use, farmland, recreation use, wetlands, green border).

Plan 17 Periodically draw down water of Iatt Lake for aquatic weed control to improve fishing resources.

Plan 18 Clear and snag bayous identified in Plan 2 and acquire in fee or acquire an easement over lands subject to flooding when floodgates must be closed.

Plan 19 Provide additional floodgates at the site of existing Bayou Rigolette structure (Plan 5) and acquire in fee or acquire an easement over lands subject to flooding when floodgates must be closed.

Plan 20 Improve the outflow to Red River by installing a pumping station near the existing floodgates.

Plan 21 No action.

A.1.10. The preliminary plans were evaluated and assessed in terms of potential acceptability, environmental impact, and engineering feasibility to a degree that was consistent with the formulation of the plans. Generally, the following criteria were applied:

- The plan must indicate technical feasibility using accepted engineering methods of construction.

o The plan must be acceptable to the general public as far as can be established.

o The plan must be complete within itself and require no additional future improvements.

o Plan benefits must appear to exceed project economic costs.

o Archeological, biological, and cultural resources should be maintained, preserved, or enhanced.

Of the 21 plans analyzed in the preliminary phase, eight were eliminated from further consideration and 13 were retained. Table A-1-2 lists plans eliminated and the rationale and Table A-1-3 lists those plans retained.

TABLE A-1-2

CONCEPTUAL PLANS ELIMINATED AND RATIONALE

Plan No.	Ineffective Overall Solution	Extremely Costly	Inefficient Solution	Publicly Unacceptable Unimplementable
2	X			
7		X	X	
10		X	X	
13				X
14	X			
15	X			
16	X			
17	X			X

TABLE A-1-3

CONCEPTUAL PLANS RETAINED FOR FURTHER STUDY

Plan No.	Plan Description
1	Increase Latt Lake storage capacity.
3	Enlarge major bayous.
4	Increase Latt Lake storage and clear and snag major bayous.
5	Provide additional floodgates adjacent to the existing floodgate.
6	Divert basin flows via Bayou Darrow to Red River.
8	Clear and snag major bayous and install a pumping station adjacent to the existing floodgate.
9	Clear and snag major bayous and install additional floodgates adjacent to the existing floodgate.
11	Divert basin flow via Sam Bayou through a new channel cut to Red River.
12	Provide a series of small upstream reservoirs in the wooded upland areas.
18	Clear and snag major bayous and acquire in fee or acquire an easement over lands subject to flooding when the floodgates are closed.
19	Provide additional floodgates adjacent to the existing structure and acquire in fee or acquire an easement over lands subject to flooding when the floodgates are closed.
20	Install a pumping station adjacent to the existing structure.
21	No action plan.

SECTION 2. INTERMEDIATE PLAN FORMULATION, EVALUATION, AND ASSESSMENT

A.2.1. The reconnaissance studies identified a need for more data to better define the water and related land resources problems, needs, and opportunities. The data would also be used for more indepth studies and analysis of the alternative plans. In the intermediate stage of analysis, plan formulation, evaluation, and assessment were conducted in two phases, initial intermediate and final intermediate. The results of the analysis in each phase are separately discussed.

PROBLEM IDENTIFICATION

A.2.2. The collection of engineering, economic, and environmental data was important in further identifying problems in the area. Specific data included water quality samples, topographic channel cross sections, inventory of cultural resources, inventory of fish and wildlife resources, and inventory of recreational resources. Based on the data collected and publicly expressed concerns, the problems, needs, and opportunities were refined. The problem area is defined as the alluvial plain flooded by the 10-year frequency storm (area below the 90-foot contour) while the study area is the entire basin (composed of the alluvial plain and the wooded hill lands).

FLOOD PROBLEMS

A.2.3. At the present, flooding in the Bayou Rigolette Basin is a result of interior rainfall runoff over agricultural lands below Iatt lake. Prior to 1956, overflow from the Red River was a major cause of flooding in the basin. The Aloha-Rigolette area project, completed in 1956, addressed both problems by providing improvements in interior drainage and by restricting the Red River overflow. Features of the project include enlargement of 9.2 miles of levee and construction of 12.1 miles of new levee along the left descending bank of the Red River, closure of the mouth of Bayou Darrow from Red River, diversion of Bayou Darrow flow to Saline Bayou, approximately 31 miles of clearing and snagging in Bayou Rigolette and in Saline, Walden,

and Dry Bayous, an earthen closure separating Bayou Darrow from Bayou Rigolette, and a floodgate at Bayou Rigolette. A second floodgate at the mouth of Bayou Darrow was originally proposed as part of the project but was omitted during the design stage. The channel diversion features were substituted because of lower cost and greater contribution to improved drainage at times of high Red River stages. During high stages on Red River, the Bayou Rigolette floodgate must, of necessity, be closed to prevent backwater flooding. Closing the floodgate prevents interior tributary runoff from being evacuated. Therefore, temporary storage of the water is required until Red River stages recede. This area is drained by opening the floodgate when Red River floodwaters subside. Based on hydraulic studies conducted when the 1956 project was designed, it was determined that the area below elevation 82 feet would be flooded more often than once in 5 years with the floodgates open and should be considered a sump storage. At that time the sump was largely wooded. However, no dedication or acquisition of the sump was made as part of the project.

A.2.4. Since the Aloha-Rigolette project was completed in 1956, land use in the basin has changed greatly. Farmers, spurred by high returns, have cleared many acres of woodlands for agriculture. This clearing has resulted in increased runoff and stream siltation from the denuded land. Based on aerial photographs taken in November 1981, it was estimated that approximately 16,000 acres of woodland remain in the floodplain (100 feet contour). Most of the lands within the identified sump area below elevation 82.0 feet have been cleared. The return frequency of the 82.0-foot elevation is now computed to be exceeded once in 35 years. This increase in cleared land (now estimated at 18,800 acres), has caused an increase in rainfall runoff and some erosion. The bayous that traverse the basin are taxed with larger volumes of water and the bayous themselves are reduced by the added sediment load. The capacity of the bayous is further reduced as a result of unchecked vegetation growth. The present floodgates were not designed to handle the runoff being generated in the basin today and, as a result, backwater ponding occurs in the cleared and wooded areas

even when the floodgate is open. The Rigolette structure has been closed on four occasions since the project was completed. Landowners recognize that when the Red River is sufficiently high the gates will be closed and accept this action. Because of the infrequency of closure, it is not a major concern.

A.2.5. Another important flood factor is the topography of the agricultural lands. While the alluvial flood plain is nearly level with slopes from 0 to 1 percent, water does pond in the swales of the undulating land in many areas. Po ding results from both direct rainfall and stream overflow. The major flood problem, that of stream overflow, is addressed in the study.

A.2.6. To estimate the average annual acres flooded, the two gages in the basin were analyzed: The Pineville gage located on Bayou Rigolette 3 miles above the floodgate and the Colfax gage located on Bayou Rigolette near the Town of Colfax. By integrating stage-frequency and stage-area curves, area-probability curves were developed. From these relationships, it was determined that flooding in the Colfax area (Du Grappe Reach) occurs when stages exceed 82.2 feet and in the Rigolette area (Rigolette Reach) when stages exceed 69.0 feet. The total average annual acres flooded in the alluvial flood plain were computed to be approximately 12,620 acres. TableA-2-1 gives a breakdown of the average annual acres flooded by reach.

FISH AND WILDLIFE

A.2.8. Available data indicate that under existing and future without-project conditions habitat of suitable quality does exist to adequately satisfy hunting and fishing needs in the study area. Three major components essential to good fish habitat are adequate in-stream cover, water temperature, and dissolved oxygen. These factors are important to maintaining habitat that will satisfy fishing needs. The most valuable wildlife habitat types in the study area are bottomland hardwoods and riparian (streamside) habitat. Due to the increasing nationwide

TABLE A-2-1

TOTAL AVERAGE ANNUAL ACRES FLOODED

Reach	Cleared	Total
Rigolette	4,753	9,820
Du Grappe	1,822	2,800
	6,575	12,620

scarcity of bottomland hardwood forests, a concerted effort should be made to avoid destruction of this significant resource. Destruction of riparian habitat should also be avoided because of its high value as wildlife habitat.

RECREATION

A.2.9. Within the alluvial plain, water-oriented recreational facilities are limited and the development potential is also limited due to the extensive private land holdings, extensive clearing, and lack of public access to the streams. Population in the alluvial plain, as well as in the overall study area is relatively low, which tends to reduce the level of recreational demands. Major activities for which needs exist in the alluvial plain are fishing, boating, and camping. These needs can, however, be satisfied by existing resources within the wooded upland areas of the basin and areas immediately adjacent to the study area. Iatt Lake and the Kisatchie National Forest are located within the upland areas in the basin. Adjacent to the study area are Nantaches Lake and Lake Buhlow (restricted to just boating). The Red River also offers a potential resource that will be greatly expanded through joint development between

Federal and state interests as part of the Red River Waterway project. These existing resources adequately support existing use and offer the best opportunities for facility development to accommodate future use levels.

WATER QUALITY

A.2.10. Analysis of water quality data indicated that the quality of waterbodies in the basin above Highway 71 (largely the Iatt Lake watershed) is considered good overall while water quality below Highway 71 is considered moderate to poor. These findings are in general agreement with the Louisiana Environmental Control Commission (LECC) water use classification for Bayou Rigolette, its headwaters, and Iatt Lake. The commission classifies these waters for use as Secondary Contact Recreation and Propagation of Fish and Wildlife. Water quality conditions in the project area were determined by review of data from 13 stations. Several parameters (including hardness, alkalinity, total dissolved solids, conductivity, sulfate, and nutrients) were lowest in the upland areas and higher in the downstream Bayou Rigolette waters. Iatt Lake data indicate the lake has generally good water quality, but the Environmental Protection Agency chronic criterion for mercury is exceeded and low DO levels develop at lower depths during summer months. No pesticides or PCB's were detected in lake water samples. Bayous in the alluvial flood plain below Highway 71 generally had the highest concentrations in the project area for most water quality parameters. In Bayou Rigolette, levels tended to increase in the downstream direction. Increased concentrations of water quality parameters in waters below Highway 71 are most likely due to the movement of sediment and chemicals from the extensive crop lands in the area into nearby bayous.

A.2.11. U.S. Department of Agriculture, Soil Conservation Service, works with farmers in the area below Highway 71 to prevent erosion of agricultural lands. Numerous measures (i.e., crop residue management, tree planting, conservation tillage, cover, and green manure crops, etc.) are

presently being used in the project area. While approximately 40% of the private landowners are cooperators with SCS and have developed conservation plans on their land, further participation is expected to increase. The National Forest lands, mostly above Highway 71, are managed by the U.S. Forest Service.

A.2.12. The problems of water quality that relate to erosion areas are being addressed through SCS efforts. In this study, the effects of each alternative plan on water quality were considered and are discussed with the evaluation of each plan.

FINAL PLANNING OBJECTIVES

A.2.13. Consistent with the iterative process of plan formulation, the planning objectives formulated in the preliminary studies were reassessed and refined based on further understanding of the water resource problems, needs, and opportunities in the Aloha-Rigolette area. In the preliminary studies, the planning objectives were very broad and chosen not only to protect the environment but also to enhance such resources as bottomland hardwoods, wetlands, fish and wildlife resources, and water quality of Bayou Rigolette and its tributaries. Later in the studies, it was determined that practical measures to enhance these resources were not feasible and, in addition, the need for such enhancement was questionable. The Fish and Wildlife Service stated in a 4 May 1979 draft report that: "Our review of available data indicates that the supply of hunting and fishing opportunities is adequate to meet existing and future fishing and hunting needs in the area." Considering the limited opportunity to enhance these resources and the questionable need, the planning objectives were restated: to avoid destruction and to minimize adverse impacts. The planning objectives that guided remaining study activities are listed as follows. The order of the listing should not be interpreted as an indication of priority, although providing flood protection was the primary basis for the study authority. Providing flood protection is important, but minimizing the impacts has been expressed by some as an equal concern.

o Reduce flood losses in the alluvial plain of the Aloha-Rigolette area to increase agricultural production.

o Avoid, where possible, destruction of bottomland hardwoods, riparian habitat, and wetlands in the alluvial plain of the Aloha-Rigolette Basin in order to maintain these resources as valuable habitat.

o Minimize adverse environmental impacts associated with implementation of flood control improvements in order to maintain existing water quality and fish and wildlife resources in the alluvial plain of the Aloha-Rigolette area.

o Avoid contributing to the destruction of archeological, historical, and paleontological resources in the Aloha-Rigolette area to preserve existing conditions.

INITIAL INTERMEDIATE ASSESMENT AND EVALUATION OF PLANS

A.2.14. The major objective of the initial intermediate evaluation was to assess the effectiveness of each plan in reducing flood stages. These results were combined with the conceptual environmental and social impacts, relative cost, and views on likely public support to arrive at a decision on whether to retain or eliminate a plan. During this phase, the plans were still expressed as conceptually formulated in the reconnaissance report. In the evaluation, however, hydrologic and hydraulic models were used that were developed from channel cross-sectional data gathered subsequent to the reconnaissance report. The models were calibrated to simulate observed stages within the basin. With the models, the potential effectiveness of each plan was determined and the 13 plans were screened early in the intermediate phase.

A.2.15. The formulation concepts discussed earlier permitted several plans to be analyzed in groups. The criterion the plans were evaluated against was the degree of stage lowering throughout the alluvial plain for the 3-

and 5-year frequency events. The U.S. Soil Conservation Service has determined that agricultural flood protection projects that can contain these flood events within banks in a period of 24 hours often achieve the greatest excess benefits. This degree of protection reduces the farmer's risk and enables him to reap a reasonable return on investment. The responsiveness of the plans to this criterion was compared. Other factors considered were cost, social impacts, environmental impacts, and likely public support. As a result of this analysis, 6 of the 13 plans were eliminated. The remaining seven plans, including the "no action" option, were further developed and final intermediate analysis performed. Each alternative that survived the initial intermediate phase was analyzed further for its technical, economic, and environmental feasibility in the final intermediate phase.

CONCEPTUAL PLANS

A.2.16. Conceptual Plans 1, 11, and 12. The objective of Plans 1 and 12 was to further control Iatt Lake flow into Bayou Rigolette. Plan 11 was included in this group because it also reduced Bayou Rigolette headwater flow by diverting into the Red River approximately 4 miles downstream of Iatt Lake Dam.

A.2.17. With Plan 1, the additional storage capacity of the lake could improve fishery potential and cause an increase in water-oriented recreation activities. Controlled releases made possible by the additional storage could also improve water quality in Bayou Rigolette. This plan would require acquisition of substantial lands around the lake. Institutional and engineering difficulties may also be encountered since the dam was constructed and is owned by the State of Louisiana. These conditions may necessitate building a new structure. Increasing the storage capacity of Iatt Lake would alter terrestrial biological resources that currently exist in riparian areas. This impact is considered to be temporary because a new riparian community would establish along the new shoreline. Raising the water level of the lake could also adversely affect archeological sites along the lake's shoreline. Relocation of some camping facilities would be necessary, as well as some light duty roads.

A.2.18. Plan 11 requires that a channel approximately 0.6 miles long be constructed from Sam Bayou to Red River through largely agricultural lands. Several small bridges and culverts would have to be constructed where the new channel crosses farm roads and one railroad. Adjacent to the floodgate, a flowage easement would have to be acquired to serve as a temporary ponding area for heavy flows generated within the basin. Construction of the channel would cause conversion of approximately 20 acres of agricultural lands to open water and minor adverse impacts on terrestrial resources.

A.2.19. The small reservoirs proposed for Plan 12 would be located in the Kisatchie National Forest. The type and extent of environmental impacts are dependent on the location and size of the small reservoirs and whether permanent pools would be provided. With permanent pools, the fishing and water-oriented recreation potential would be increased, but at the expense of reduced hunting areas and terrestrial resources. Without permanent pools, the impacts would depend on the detention time in the reservoirs and the maximum reservoir surface area. The U.S. Department of Agriculture, Soil Conservation Service, proposed a similar plan in 1968 for the Aloha-Rigolette Basin, utilizing a system of small reservoirs and channel modification. The SCS proposal provided for 11 reservoirs with surface areas totalling 5,260 acres and 81 miles of channel modification. While this plan was economically feasible, it was contingent on additional gates being installed in the Red River levee at the mouth of Bayou Rigolette. Local interests were unable to meet the terms of local cooperation required for the SCS plan.

A.2.20. In evaluating this group of alternatives, the Iatt Lake flow was simulated as being completely removed from the basin (the greatest possible effect of these plans on the alluvial plain). An analysis was then made of the remaining basin to determine the water surface elevations for 1-, 3-, 5-, 10-, 25-, 50-, 100-year, and SPF (Standard Project Flood) frequency storms. This analysis resulted in multiple profile plots along Bayous Rigolette, Sam, Saline, and Darrow. From this analysis, it was determined

that these plans would have very little effect on lowering stages within the alluvial problem areas, particularly in the middle to lower reaches of the agricultural area. The 3- and 5-year events remained above banks for nearly the entire length of Bayou Rigolette. Thus, the benefited area would be limited to the upper alluvial plain with substantial flood damages remaining in the middle and lower basin. The costs for implementing Plans 1 and 12 in comparison to other plans are considered high and the cost for Plan 11 is considered moderate. Overall, other plans better addressed the flood problem. Thus, these plans were eliminated from further study.

A.2.21. Conceptual Plan 3. The objective of this plan was to increase the basin storage capacity by increasing the size of the bayous in the alluvial area. Depending on the degree of channel enlargement, relocation of roads and pipelines may be required. Environmental impacts are also expected to be significant with implementation of this plan. Local support for this plan is considered unlikely because it does not provide additional outlet capacity to the Red River. A complicated analysis which was beyond the scope of the initial intermediate phase, would be required to determine the plans responsiveness to flooding. Since flooding is the primary water resource problem in the basin and it is necessary to evaluate the flooding impact of this plan, the plan was retained for further study.

A.2.22. Conceptual Plan 4. This plan embraced two concepts: control flow above Iatt Lake and improve the efficiency of channels within the alluvial area. The evaluation of this plan combined the analysis of Plans 1, 11, and 12 with evaluation of clearing and snagging Bayous Rigolette, Saline, and Du Grappe, Sugarhouse, Marteau, and Darrow. The results indicated greater lowering than Plans 1, 11, and 12, but the 3- and 5-year events remained above the banks for substantial reaches of Bayous Rigolette and Darrow. In comparison to other plans, this plan was less effective in reducing flooding.

A.2.23. The environmental impacts of this plan are as described for Plan 1 with additional impacts associated with the clearing and snagging component. Clearing and snagging would temporarily destroy the riparian

habitat located along the streambanks. Revegetation would occur but would be interrupted by periodic major maintenance. The cost of this plan would be high because of the number of miles likely to be affected, the dam modification required at Iatt Lake, and the possible relocation of camps. Support for this plan is also unlikely because no additional outlet capacity into the Red River would be provided. Based on these probable impacts, which are greater than in the other plans, and the only partial response to the flood control objective, this plan was eliminated from further study.

A.2.24. Conceptual Plans 5, 19, and 20. The objective of these plans was to increase the discharge capacity of the existing Bayou Rigolette floodgate by adding more floodgates or by installing pumps. The approach to analyzing these plans was to address the question of whether installing the largest possible floodgate would substantially lower stages. This was answered by simulating free flow conditions between Bayou Rigolette and Red River. The results of this analysis indicated a significant lowering of the 3-year and 5-year events throughout the lower basin and moderate lowering in the upper basin areas along Bayou Rigolette.

A.2.25. The construction impacts of these plans would be minimal. No more than 20 acres would be needed for construction. Affects on aquatic and terrestrial resources will be only short term. Any additional environmental impacts will result from possible project-induced clearing or reduction in flooded forest. None of these possible plan effects were evaluated for this or any plans at this phase. The costs of each of these plans are expected to differ substantially. Plan 5 would be the least costly of the three plans and Plan 20 the most costly. It is expected that the public would support the concept of additional outlet capacity into the Red River. However, depending on the cost of the pumping station and the land acquisition component of Plans 20 and 19, respectively, local interests may or may not endorse the plans. Because each plan appears to effectively reduce flooding and have minimal environmental impacts, these plans were retained for further study.

A.2.26. Conceptual Plan 6. The objective of this plan was to reduce Bayou Rigolette headwater flow by diverting into the Red River at the previously closed mouth of Bayou Darrow. This plan was evaluated by separating the Bayou Darrow-Saline watersheds from the Bayou Rigolette Basin. The resulting stages were only minimally lower than existing without-project stages. Lowerings that were achieved were concentrated in the upper reaches of Bayou Rigolette. Based on these results, further studies were not warranted. However, at a meeting in Colfax, Louisiana, with representatives of the Rigolette Water Relief Association on 10 March 1983, local residents expressed a strong desire for this plan to be studied in greater detail. Therefore, the plan was retained for further study.

A.2.27. Conceptual Plans 8 and 9. The approach to formulating and evaluating Plans 8 and 9 followed that of Plans 5, 19, and 20. The purpose of Plans 5, 19, and 20, was to increase the discharge capacity of the existing floodgate. In Plans 8 and 9, clearing and snagging was included to increase the efficiency of the channels. Incorporating these two concepts in Plans 8 and 9, increasing the outlet capacity and the efficiency of channels, proved very effective in reducing stages throughout the basin. Recognizing that the net effect of each plan was essentially the same, Plan 9 was retained and Plan 8 eliminated from further study because of a higher cost associated with pumping stations. The concept of a pumping station was retained in Plan 20 in order to compare benefits to other alternatives.

A.2.28. Conceptual Plan 18. The objective of this plan was to increase the efficiency of major bayous and increase channel carrying capacity. The lands that would continue to be subject to flooding when the floodgates were closed would either be acquired or an easement obtained. The results of evaluating clearing and snagging indicated that stages would be appreciably lower in the alluvial plain above Colfax, Louisiana, but out-of-bank flooding would continue throughout the alluvial plain below Colfax. The channel capacity added by clearing and snagging would make very little difference in the with- and without-project conditions when the

floodgates were closed. The number of acres proposed for acquisition or easement would be large and prohibitively expensive. Therefore, this plan was eliminated from further study.

FINAL INTERMEDIATE FORMULATION, ASSESSMENT, AND EVALUATION OF PLANS

A.2.29. The objective of this phase was to increase the level of detail of the remaining plans to permit further plan assessment, evaluation, and selection. The plans were asssessed to identify and evaluate the probable economic, social, and environmental impacts. These impacts can be caused by:

o The input required to carry out a proposed action (i.e., capital, labor, energy resources).

o The action itself (i.e., physical alteration, structures, acquisition).

o The operation and maintenance requirements.

o The impacts of the output from the proposed action (i.e., flood control, recreation, water quality).

A.2.30. In this phase, determining economic feasibility was significant. Therefore, the capital and natural resources required to implement each plan were assessed and detailed economic and design cost studies were conducted. Prior study activities considered cost in general terms along with the potential benefits to be derived. However, in this phase, benefits and costs associated with inundation reduction were analyzed in detail so further refinement would not be required regardless of the plans selected for final consideration. Those costs and benefits associated with mitigating unavoidable environmental losses were excluded. From a plan formulation perspective, it was necessary to first establish each plan's responsiveness to flood reduction, and then select plans for final studies. This order of plan formulation would limit the number of mitigation plans to be developed.

A.2.31. In plan evaluation, the beneficial and adverse contributions of each plan were determined. The criteria used to test plan responsiveness were acceptability, completeness, effectiveness, efficiency, and the NED benefit-to-cost ratio. Generally in agricultural areas, the primary benefits are directly associated with inundation reduction and the major adverse impacts are associated with acres affected through direct construction and project-induced woodland clearing.

A.2.32. Each plan was sized by selecting a reasonable configuration based on the defined flood problem, probable stage lowering to be achieved, and the professional experience and judgment gained in studying other agricultural problem areas. A range was provided for each plan by sizing options larger and smaller than the initial selection. Deviations from this approach are discussed with the particular plan.

A.2.33. In addition to the structural and nonstructural plans evaluated in the preliminary and initial intermediate assessements, a new plan was added to be assessed in the final intermediate phase. The new plan was designated the "no structure" alternative. The idea for the plan originated after it was noted that the existing Bayou Rigolette floodgate had been operated to protect against Red River backwater only four times since its construction in 1956. The plan would consist of removing the Bayou Rigolette floodgate and leaving a gap in the Red River levee at the mouth of Bayou Rigolette.

PLAN 3 - CHANNEL MODIFICATION

A.2.34. The bayous studied included Rigolette (with a portion of Walden Bayou), Darrow, Marteau, DuGrappe, Sugarhouse, Sam, and Saline (see Figure 1). The channels were analyzed as all being cleared and snagged (Plan 3A), some channel and channel segments being cleared and snagged and others being enlarged (Plan 3B), and channels being further enlarged (Plan 3C). In Plan 3A, a total of 60 miles of channel would be cleared and snagged. In Plans 3B and 3C, 26.3 miles of channel would be cleared and snagged and

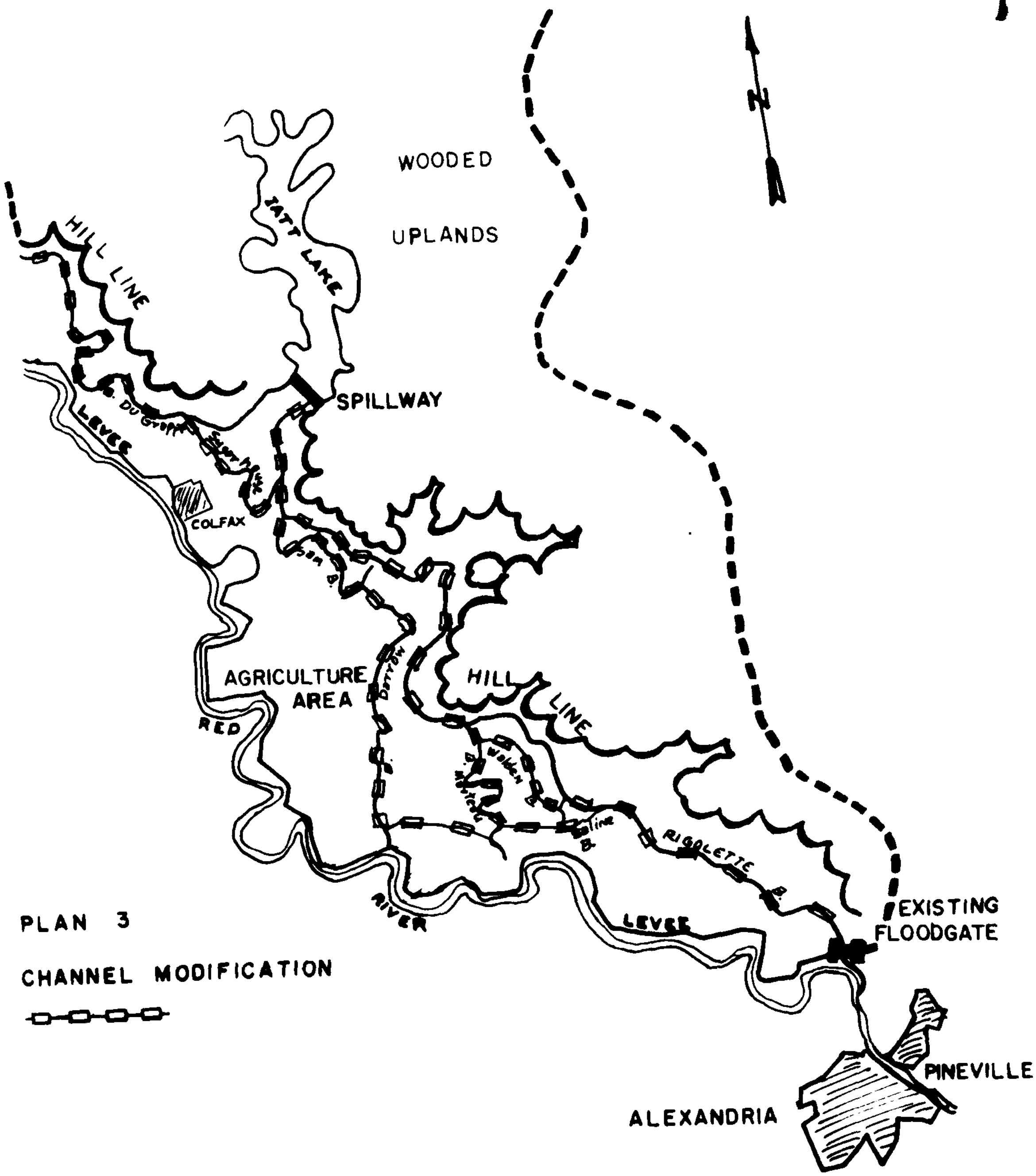

WOODED
UPLANDS
IATT LAKE
HILL LINE
SPILLWAY
LEVEE
COLFAX
AGRICULTURE AREA
RED
RIVER
HILL LINE
RIGOLETTE B.
LEVEE
EXISTING FLOODGATE
PINEVILLE
ALEXANDRIA
PLAN 3
CHANNEL MODIFICATION

FIGURE 1

33.7 miles would be enlarged. Table A-2-2 provides a summary of the bayous and the length affected. To reduce environmental impacts associated with channel modification, channel segments narrow enough to permit construction equipment to operate from one side were identified and appropriate costs were incorporated in each option. The shallow depth of the bayous, channel width, and the heavy vegetation growth make it necessary to use both banks when clearing Bayous Rigolette and Marteau.

A.2.35. Land required for construction rights-of-way and disposal easements are tabulated in Table A-2-3 along with the excavation quantities. Figures 2 and 3 provide illustrations of typical channel cross sections and disposal easements, respectively. Plan 3A would affect approximately 1,124 acres, Plan 3B would affect 1,400 acres, and Plan 3C would affect 1,529 acres. These affected areas are all riparian habitat comprised of wooded and cleared land that has high habitat value in an agricultural area. The estimated costs to implement these options are $3.7 million for Plan 3A, $10.3 million for Plan 3B, and $12.6 million for Plan 3C. Detailed evaluation of costs are given in Appendix C, Engineering Investigations.

A.2.36. It was the intent of the final intermediate assessment to develop cost-benefit ratios for each alternative considered. However, Plan 3 became the exception. With- and without-project stage-frequency curves were developed for Plans 3A, 3B, and 3C, which are shown on Plates C-5 and C-6. The computations show that Plans 3A, 3B, and 3C would increase flood stages in the vicinity of the Pineville gage for all frequency storms with these projects in place. Plans 3A, 3B, and 3C would induce flooding in the lower area of the basin, produce negative flood control benefits, and would be unacceptable to local residents. Residents of the basin and local agencies have expressed the view that without additional means of evacuating the water into the Red River, improvements in the efficiency and capacity of the channels would be unacceptable. The lack of support for this concept as a single approach in Plans 3A, 3B, and 3C and the extent of mitigation measures that would be required would make these plans unimplementable. Thus, these studies were discontinued.

A-2-2

DEGREE OF CHANNEL MODIFICATION
PLAN 3

Bayous	Stream Mile	Plan 3A Channel Invert (NGVD)	Plan 3A Bottom Width (ft)	Plan 3A Side Slopes	Plan 3B Channel Invert (NGVD)	Plan 3B Bottom Width (ft)	Plan 3B Side Slopes	Plan 3C Channel Invert (NGVD)	Plan 3C Bottom Width (ft)	Plan 3C Side Slopes
Bayou Rigolette & Walden Bayou	0.0	54.5			52.5			51.5		
	--	--	Cleared & Snagged		--	40	1V on 3H	--	40	1V on 3H
Bayou Rigolette & Walden Bayou	4.2	56.4			54.5			53.5		
	-	--	Cleared & Snagged		--	15	1V on 3H	--	21	1V on 3H
Bayou Rigolette & Walden Bayou	7.7	58.5			56.5			55.5		
	--	--	Cleared & Snagged		--	16	1V on 3H	--	23	1V on 3H
Bayou Rigolette & Walden Bayou	20.0	66.3			66.7			65.7		
	--	--	Cleared & Snagged		--	Cleared & Snagged		--	Cleared & Snagged	
Bayou Rigolette & Walden Bayou	23.3	69.4			67.4			66.4		
	--	--	Cleared & Snagged		--	35	1V on 3H	--	35	1V on 3H
Bayou Rigolette & Walden Bayou	25.7	71.4			69.4			68.4		
Saline Bayou & Diversion Channel	0.0	58.5			56.5			55.5		
	--	--	Cleared & Snagged		--	5	1V on 1H	--	8	1V on 3H
Saline Bayou & Diversion Channel	2.2	66.0			65.0			64.5		
	--	--	Cleared & Snagged		--	5	1V on 3H	--	8	1V on 3H
Saline Bayou & Diversion Channel	4.1	68.7			67.7			67.2		
	--	--	Cleared & Snagged		--	5	1V on 3H	--	8	1V on 3H
Saline Bayou & Diversion Channel	5.5	64.6			64.6			64.6		
Bayou Darrow	0.0	64.6			64.6			64.6		
	--	--	Cleared & Snagged		--	Cleared & Snagged		--	Cleared & Snagged	
Bayou Darrow	0.5	64.6			64.6			64.6		
	--	--	Cleared & Snagged		--	Cleared & Snagged		--	Cleared & Snagged	
Bayou Darrow	1.8	66.6			66.4			66.4		
	--	--	Cleared & Snagged		--	14	1V on 3H	--	21	1V on 3H
Bayou Darrow	7.6	67.5			67.5			67.5		
Bayou Marteau	0.0	67.8			67.8			67.8		
	--	--	Cleared & Snagged		--	Cleared & Snagged		--	Cleared & Snagged	
Bayou Marteau	0.40	67.8			67.8			67.8		
	--	--	Cleared & Snagged		--	Cleared & Snagged		--	Cleared & Snagged	
Bayou Marteau	3.6	67.7			67.7			67.7		
	--	--	Cleared & Snagged		--	Cleared & Snagged		--	Cleared & Snagged	
Bayou Marteau	6.0	67.7			67.7			67.7		
Sam Bayou	0.0	66.3			66.7			65.7		
	--	--	Cleared & Snagged		--	Cleared & Snagged		--	Cleared & Snagged	
Sam Bayou	0.3	67.1			67.1			67.1		
	--	--	Cleared & Snagged		--	Cleared & Snagged		--	Cleared & Snagged	
Sam Bayou	4.8	79.3			79.3			79.3		
Du Grappe & Sugarhouse	0.0 to 12.2	-	Cleared & Snagged		-	Cleared & Snagged		-	Cleared & Snagged	

TABLE A-2-3

PLAN 3 - REAL ESTATE REQUIREMENTS

Plan Option	Construction Berm (Ac.) Wooded	Construction Berm (Ac.) Cleared	Construction Berm (Ac.) Total	Disposal (Ac.) Wooded	Disposal (Ac.) Cleared	Disposal (Ac.) Total	Type Disposal Area 2/	Total Acreages	Excavated Quantities (cu. yd.)
PLAN 3A									
Bayou Rigolette Mi. 0 to Mi. 25.7	162	88	250	63	65	128	CB mounds - 275' long & 75' wide	378	c/s 1/
Bayou Darrow Mi. 0 to Mi. 7.6	30	44	74	13	25	38	CB mounds - 275' long & 75' wide	112	c/s
Bayou Marteau Mi. 0 to Mi. 4.0	39	0	39	0	15	15	CB mounds - 200' long & 75' wide	54	c/s
Sam Bayou Mi. 0 to Mi. 5.0	9	9	18	0	18	18	CB mounds - 200' long & 75' wide	36	
Saline Bayou Mi. 0 to Mi. 5.5.	27	0	27	3	9	12	CB mounds - 200' long & 75' wide	39	c/s
Bayou Du Grappe & Sugarhouse Mi. 0 to Mi. 12.2	21	31	52	3	34	37	CB mounds - 200' long & 75' wide	89	c/s
TOTAL PLAN 3A	288	172	460	82	166	248		708 4/	
PLAN 3B									
Bayou Rigolette Mi. 0 to Mi. 20.8	125	77	202	105	97	202	EB 40' wide	(404)	1,070,000
Mi. 20.8 to Mi. 22.7	18	0	18	1	7	8	CB mounds - 275' long & 75' wide	(26)	
Mi. 22.7 to Mi. 25.7	19	11	30	7	13	20	EB 26' wide	(50)	
Subtotal	162	88	250	113	117	230		480	
Bayou Darrow Mi. 0 to Mi. 1.8	9	9	18	2	7	9	EB 75' wide	(27)	55,000
Mi. 1.8 to Mi. 7.6	21	35	56	10	16	26	EB 18' wide	(82)	
Subtotal	30	44	74	12	23	35		109	
Bayou Marteau Mi. 0 to Mi. 4.0	39	0	39	0	15	15	CB mounds - 200' long & 75' wide	54	c/s
Sam Bayou Mi. 0 to Mi. 5.0	24	24	48	0	18	18	CB mounds - 200' long & 75' wide	60	c/s

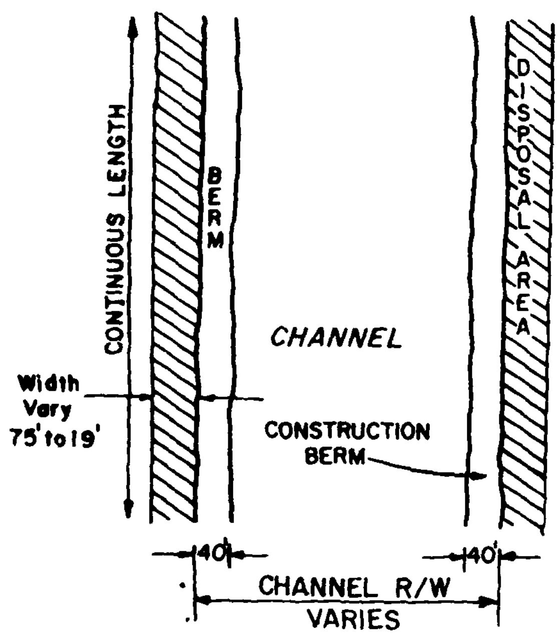
TABLE A-2-3

PLAN 3 - REAL ESTATE REQUIREMENTS (Continued)

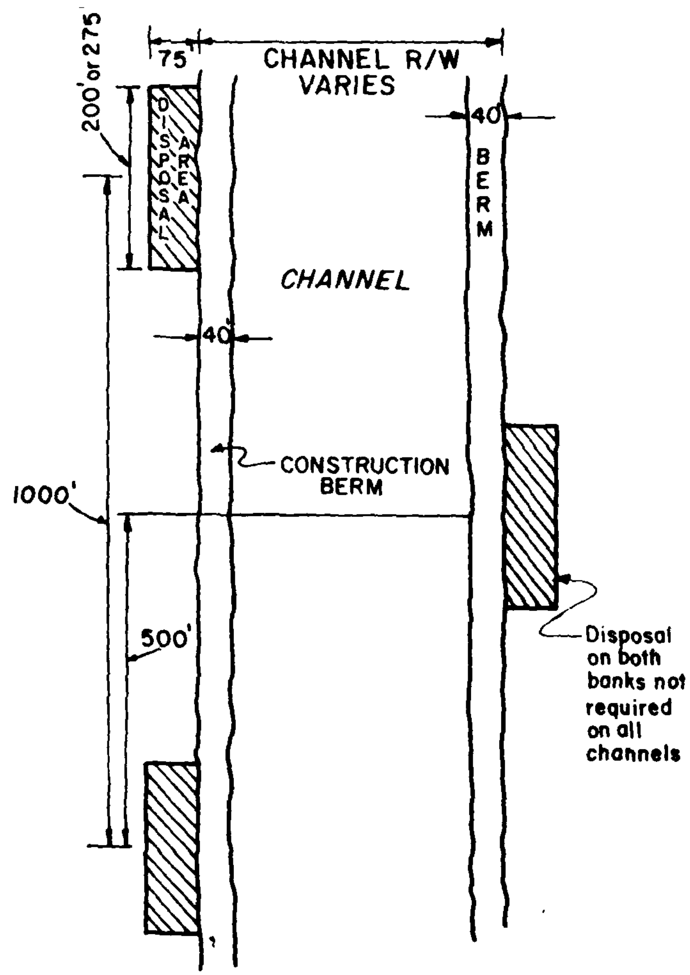
Plan Option	Construction Berm Wooded	Construction Berm Cleared (Ac.)	Construction Berm Total	Disposal Wooded	Disposal Cleared (Ac.)	Disposal Total	Type Disposal Area 2/	Total Acreages	Excavated Quantities (cu. yd.)
PLAN 3B (Cont'd)									
Saline Bayou Mi. 0 to Mi. 5.5	53	0	53	15	44	59	EB - 44' wide	112	315,000
Bayous Du Grappe & Sugarhouse Mi. 0 to Mi. 12.2	48	70	118	4	41	45	EB - 30' wide	163	131,000
								984 4/	
TOTAL PLAN 3B	356	226	582	144	258	402			
PLAN 3C									
Bayou Rigolette Mi. 0 to Mi. 20.8	125	77	202	149	138	287	EB - 57' wide	(489)	1,929,000
Mi. 20.8 to Mi. 22.7	18	0	18	1	9	10	CB mounds - 275' long & 75' wide	(28)	
Mi. 22.7 to Mi. 25.7	19	11	30	14	23	37	EB - 49' wide	(67)	
Subtotal	162	88	250	164	170	334		584	
Bayou Darrow Mi. 0 to Mi. 1.8	9	9	18	2	7	9	CB mounds - 275' & 75' wide	(27)	80,000
Mi. 1.8 to Mi. 7.6	21	35	56	14	22	36	EB - 26' wide	(92)	
Subtotal	30	44	74	16	29	45		119	
Bayou Marteau Mi. 0 to Mi. 4.0	39	0	39	0	15	15	CB mounds - 200' long & 75' wide	54	c/s
Sam Bayou Mi. 0 to Mi. 5.0	24	24	48	0	18	18	CB mounds - 200' & 75' wide	66	c/s
Saline Bayou Mi. 0 to Mi. 5.5	53	0	53	19	55	74	EB - 55' wide	127	435,000
Bayous Du Grappe & Sugarhouse Mi. 0 to Mi. 9.3	45	45	90	0	34	34	EB - 30' wide	(34)	131,000
Mi. 9.3 to Mi. 12.2	3	25	28	4	7	11	CB mounds - 200' long & 75' wide	(11)	
Subtotal	48	70	118	4	41	45		163	
								1,113 4/	
TOTAL PLAN 3C	356	226	582	203	328	531			

1/ c/s - Clearing and snagging no excavation required
2/ ch - Checkboard
3/ eb - Each bank
4/ Totals exclude 416 acres of water bottoms owned by the State of Louisiana which would be affected [illegible] modification.

TYPICAL DISPOSAL CONFIGURATION



CONTINUOUS BANK DISPOSAL



CHECKERBOARD DISPOSAL

FIGURE 2

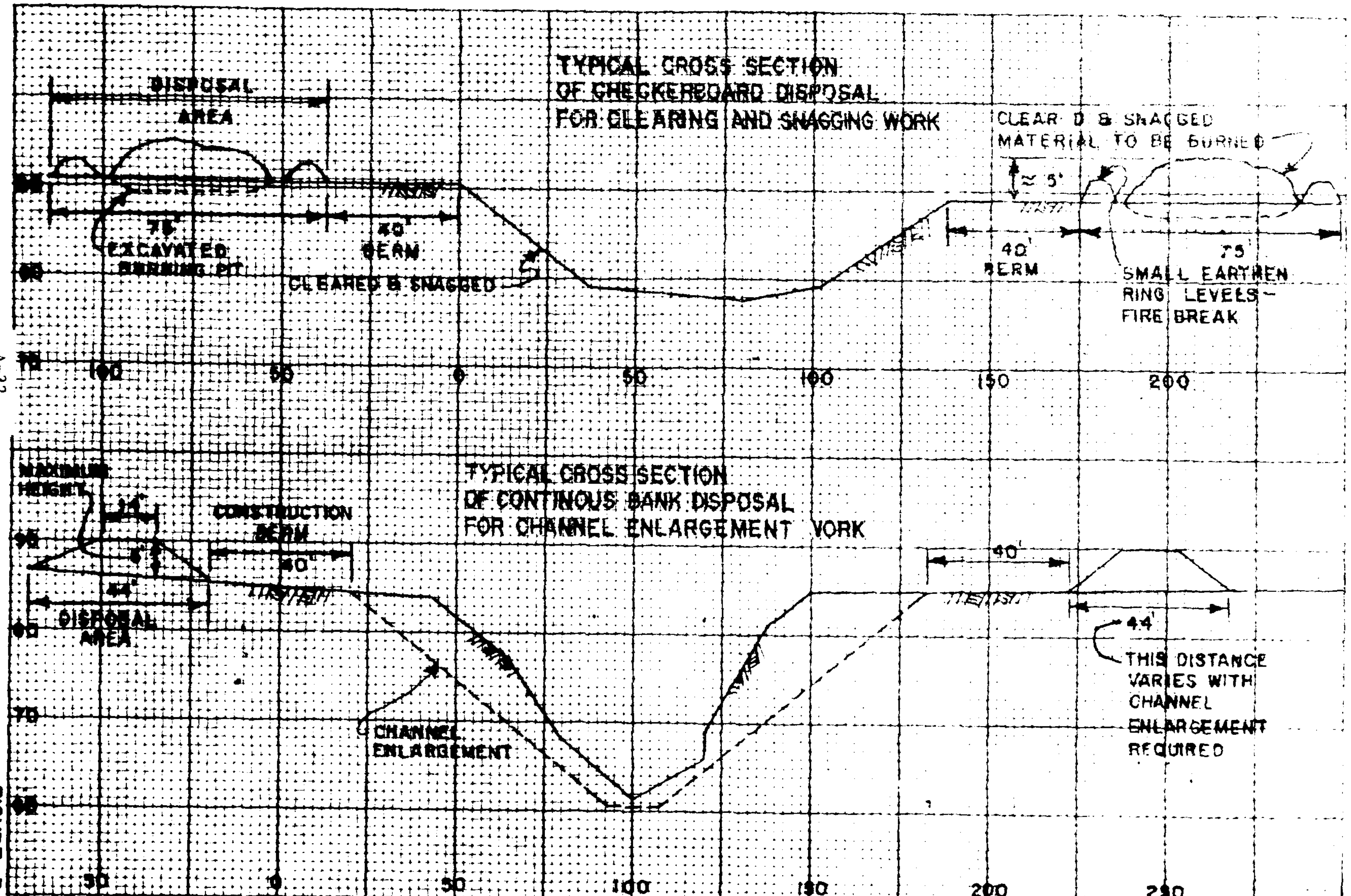

TYPICAL CROSS SECTION
OF CHECKERBOARD DISPOSAL
FOR CLEARING AND SNAGGING WORK
DISPOSAL
AREA
75'
EXCAVATED
BURNING PIT
40'
BERM
CLEARED & SNAGGED
CLEAR D & SNAGGED
MATERIAL TO BE BURNED
≈ 5'
40'
BERM
75'
SMALL EARTHEN
RING LEVEES -
FIRE BREAK
100
50
0
50
100
150
200
TYPICAL CROSS SECTION
OF CONTINOUS BANK DISPOSAL
FOR CHANNEL ENLARGEMENT WORK
MAXIMUM
HEIGHT
14'
6'
44'
DISPOSAL
AREA
CONSTRUCTION
BERM
40'
CHANNEL
ENLARGEMENT
40'
44'
THIS DISTANCE
VARIES WITH
CHANNEL
ENLARGEMENT
REQUIRED
50
0
50
100
150
200
250

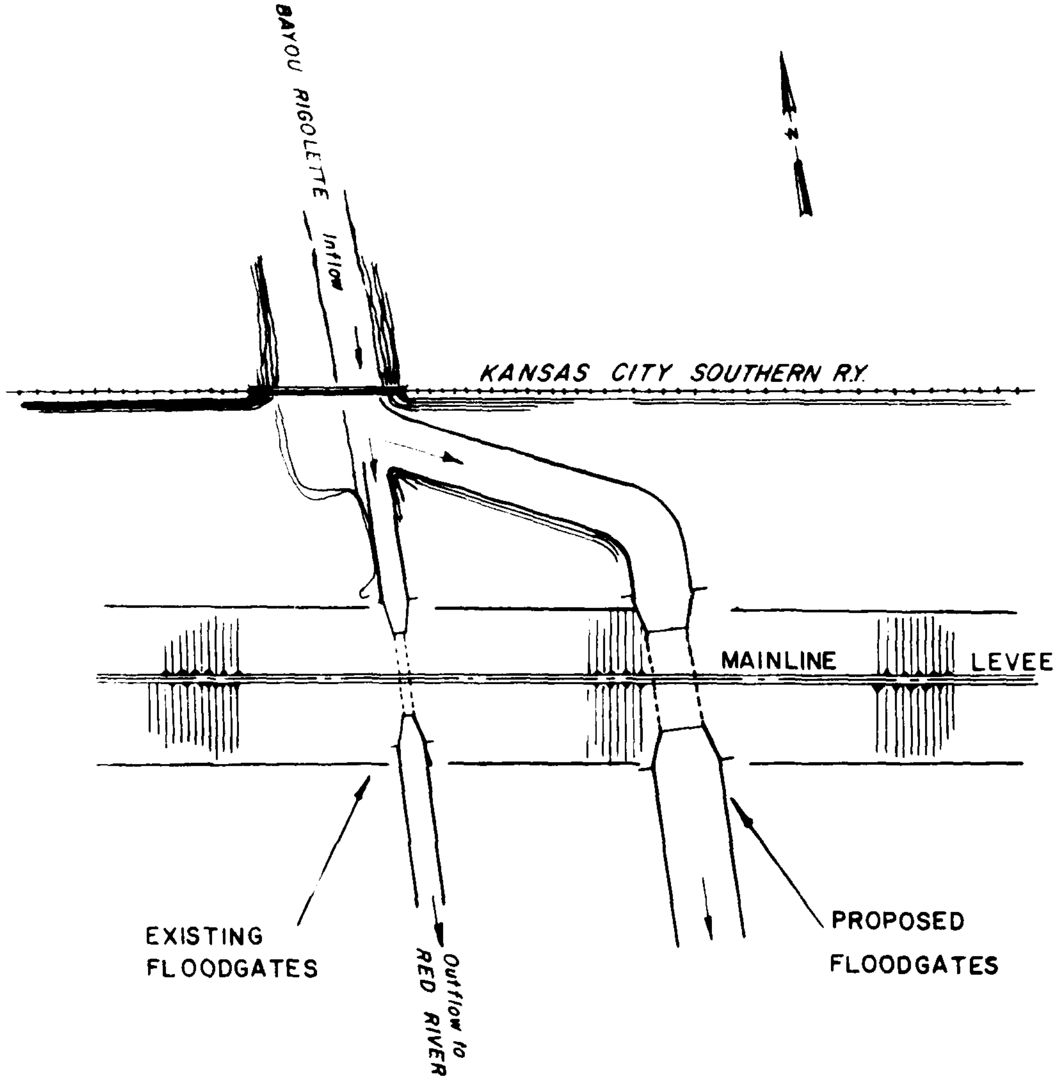
FIGURE 3

A.2.37. In summary, the overall analysis of this plan indicates that it would not be economically feasible, would not be effective as a complete solution, would cause greater environmental impacts than other plans being considered, and would probably be unacceptable to the public as a single solution. Therefore, this plan was eliminated from further study.

PLAN 5 - BAYOU RIGOLETTE FLOODGATES

A.2.38. Existing floodgates at the mouth of Bayou Rigolette include two 10- by 10-foot box culverts. Options analyzed for this plan included the addition of two more 10- by 10-foot culverts (Plan 5A), four more 10-by 10-foot gated culverts (Plan 5B), six more 10- by 10-foot gated culverts (Plan 5C), and eight more 10- by 10-foot gated culverts (Plan 5D). The new floodgates would be located approximately 600 feet east of the existing floodgates (see Figure 4). The inflow channel would begin just south of the Kansas City Southern Railway and extend 680 feet to the new floodgates. Culverts for all plan options are to be 210 feet in length. The outflow channel would extend 1,010 feet and merge into the existing structure outlet channel. Bottom width of both inflow and outflow channel would be 100 feet. Riprap is required at the inlet and outlet apron of the culverts and also at the point where the new channel diverges from the existing bayou.

A.2.39. The rights-of-way required for all plan options are equal and are all wooded. The inflow and outflow channels would require approximately 11 acres and the construction cofferdam (temporary easement) 9 acres. For the floodgate with two culverts, an estimated 121,000 cubic yards of material would have to be excavated for the structure and the channel. For 4, 6, and 8 floodgates, 133,000 cubic yards, 145,000 cubic yards, and 180,000 cubic yards, respectively, of material would have to be excavated. The cost of Plan 5A was estimated to be $4.4 million, Plan 5B was $5.6 million, Plan 5C was $6.8 million, and Plan 5D was $8.0 million.



PLAN 5

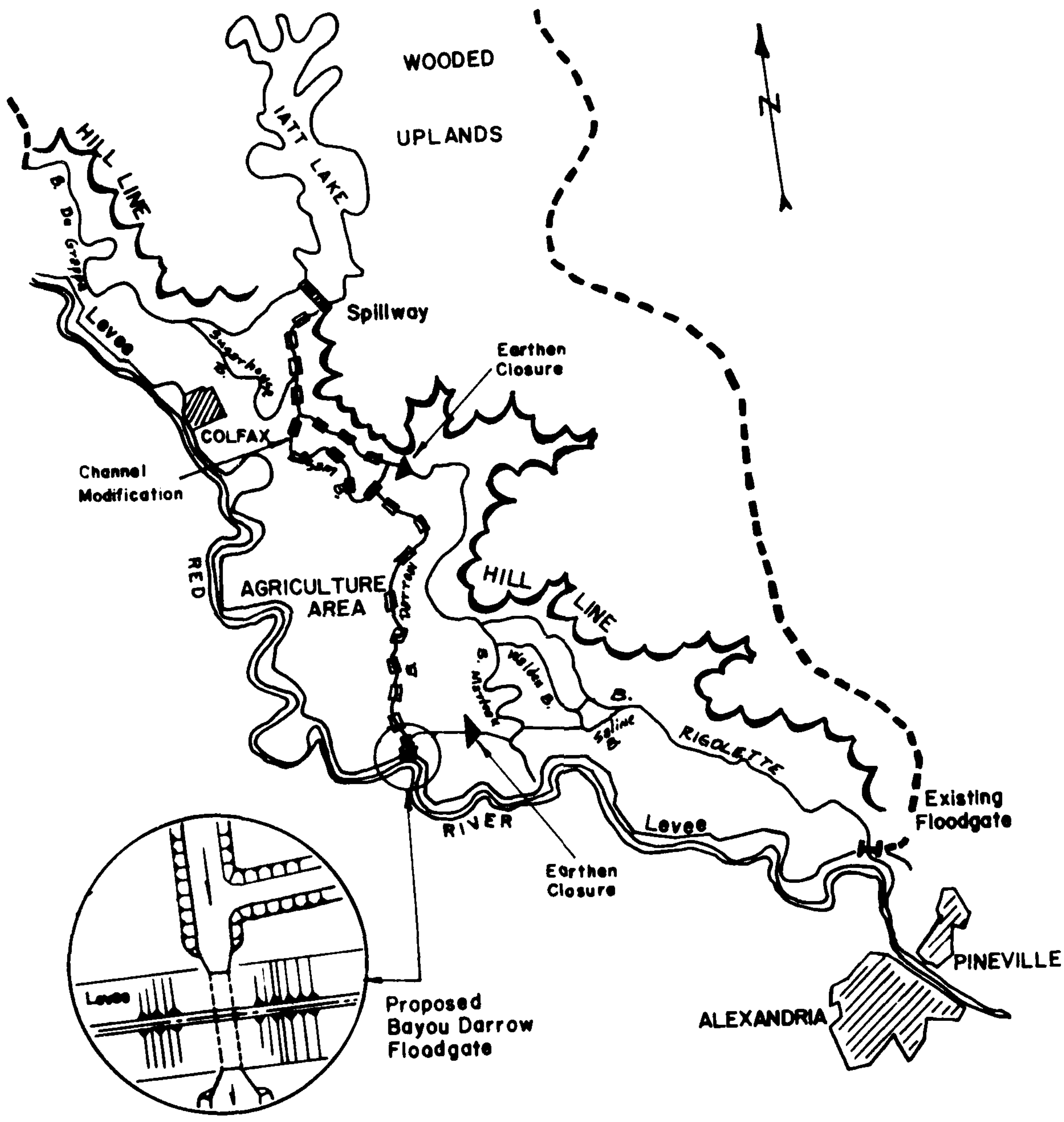
ADDITIONAL FLOODGATES

FIGURE 4

A.2.40. Option "B" of Plan 5 was analyzed and evaluated against the criteria established. Based on the analysis, this option reduced the average annual acres flooded by 41 percent and would result in intensified agricultural use on an estimated 2,653 acres. Total average annual damage reduction and intensification benefits were estimated at $966,000. The annual charges for this plan are $560,000, not including environmental costs, resulting in a B/C ratio of 1.7. The unavoidable construction impacts associated with this plan are minimal. Therefore, the B/C ratio can be expected to remain relatively constant when action to mitigate adverse environmental impacts are included. The stage-frequency curves for Plans 5A, 5C, and 5D show that the stage lowerings achieved are similar to the lowerings of Plan 5B. Considering that the costs of all options of Plan 5 are proportionate, it is reasonable to assume that these plans would also be economically feasible. The concept of additional outlet capacity is generally acceptable to residents throughout the basin and to local and state agencies. Any lack of support would probably be from upper basin landowners (Grant Parish) who would be benefited to a lesser extent than land owners in the lower basin (Rapides Parish). Plan 5 appears to be an effective and efficient solution to the flood problem. Further study of this plan is warranted.

PLAN 6 - BAYOU DARROW FLOODGATES

A.2.41. To analyze this plan, as requested by local interests at the 10 March 1983 meeting, diversion of Bayou Rigolette flow down Bayou Darrow was analyzed (see Figure 5). This was done by simulating removal of the closure between Bayou Darrow and Bayou Rigolette and placing an earthen closure on Bayou Rigolette just below the juncture. The flow diverted down Bayou Darrow would then enter the Red River via floodgates. To prevent the added flow in Bayou Darrow from seeking a path down the existing diversion channels and to provide a sump area near the proposed Bayou Darrow floodgates, an earthen closure would be constructed across the diversion channel. With the closures in place, the basin would be separated into two watersheds. (These two hypothetical watersheds do not coincide with the



PLAN 6

BAYOU DARROW FLOODGATE

FIGURE 5

boundaries of the Rigolette and DuGrappe reaches delineated in Appendix D, Economic Analysis.) Separate analyses were made for the areas above and below the proposed Bayou Rigolette closure and the diversion channel closure. Analysis of the area below the closures indicated substantial stage lowering along Bayou Rigolette without further improvements to the Bayou Rigolette floodgate or its channel.

A.2.42. Four plan options were developed that would lower stages equally in the Bayou Darrow area. All plan options included channel modification, floodgates, channel closures, and removal of an earthen closure. The difference in each option was the degree of channel modification and the number of floodgates. A minimum of four 10- by 10-foot gated culverts and clearing and snagging were determined to be necessary for each plan. Plan 6A, 6B, 6C, and 6D included 4, 5, 6, and 7 floodgates, respectively. A total of 12.4 miles of channel would be cleared and snagged and 10.8 miles enlarged under Plans 6A and 6B. However, enlargement under Plan 6A is greater than enlargement proposed under Plan 6B. Plan 6C and 6D incorporated only clearing and snagging of 23.2 miles. Table A-2-4 provides a summary of pertinent data on each plan option.

A.2.43. The estimated real estate requirements for features of these plan options are shown in Table A-2-5. The total requirement for Plan 6A is 366 acres, for Plan 6B is 323 acres, and for Plan 6C and 6D is 302 acres. The acreage for each plan was composed of approximately 47 percent wooded riparian habitat and 53 percent cleared riparian habitat. The estimated cost of Plan 6A is \$11.6 million, of Plan 6B is \$11.0 million, of Plan 6C is \$10.7 million, and of Plan 6D is 11.7 million without invironmental costs. Based on an economic evaluation of this plan, the average annual acres flooded would be reduced 81 percent and intensified agricultural use would occur on an estimated 25,186 acres. Total inundation reduction and intensification benefits were estimated to be \$1,704,000, not including environmental costs. The annual charges for Plan 6B are \$1,244,000, not including environmental costs, and the B/C ratio would be 1.4. Plan 6 appears to be a viable solution to the problem because it produces stage lowerings througout the basin. The plan would be effective and very acceptable to basin residents. Further study of this plan is warranted.

TABLE A-2-4

DEGREE OF CHANNEL MODIFICATION

Plan 6

I. Channel Modification

A. Plan 6A

Stream	Mileage	Bottom Width (ft)	Side Slopes
Darrow	0.0 to 7.6	30	IV on 3H
Rigolette	20.0 to 20.8	35	IV on 3H
Rigolette	20.8 to 23.3	Cleared and Snagged	-
Rigolette	23.3 to 25.7	55	IV on 3H
Sam	0.0 to 4.4	Cleared and Snagged	-

B. Plan 6B

Stream	Mileage	Bottom Width (ft)	Side Slopes
Darrow	0.0 to 7.6	25	IV on 3H
Rigolette	20.0 to 20.8	30	IV on 3H
Rigolette	20.8 to 23.3	Cleared and Snagged	-
Rigolette	23.3 to 25.7	55	IV on 3H
Sam	0.0 to 4.4	Cleared and Snagged	-

C. Plan 6C & 6D

Stream	Mileage	Bottom Width (ft)	Side Slopes
Darrow	0.0 to 7.6	Cleared and Snagged	-
Rigolette	20.0 to 25.7	Cleared and Snagged	-
Sam	0.0 to 4.4	Cleared and Snagged	-

II. Floodgates

	Plan	No. of Culverts	Size	Length (ft)
A.	6A	4	10' x 10'	284
B.	6B	5	10' x 10'	284
C.	6C	6	10' x 10'	284
D.	6D	7	10' x 10'	284

III. Earthen Closures

Plan 6A, 6B, 6C, and 6D

Stream	Length (ft)	Height (ft)	Crown Width (ft)	Side Slopes
Rigolette	200	20	10	IV on 4.5H
Saline	200	16	10	IV on 4.5H

IV. Removal of Earthen Closure on Bayou Darrow

Plan	Excavated Quantities (cu. yd.)
6A, 6B, 6C, & 6D	145,800

TABLE A-2-5

REAL ESTATE REQUIREMENTS

Plans 6A, 6B, 6C, & 6D

Plan Features	Option 6A (acres)		Option 6B (acres)		Option 6C & 6D (acres)	
	Wooded	Clear	Wooded	Clear	Wooded	Clear
Floodgate						
Temporary easement 1/	5	4	5	4	5	4
Permanent R/W	6	5	6	5	6	5
Channel						
Temporary easement 2/	51	130	37	101	26	91
Permanent R/W	90	60	90	60	90	60
Earthen Closure Removed						
Temporary easement 2/	8	-	8	-	8	-
Permanent R/W	7	-	7	-	7	-
Total	167	199	153	170	142	160

1/ Right-of-way needed for cofferdam.
2/ Right-of-way needed for disposal areas.

PLAN 9 - BAYOU RIGOLETTE FLOODGATES AND CLEARING AND SNAGGING

A.2.44. This plan represents a combination of Plan 5 and Plan 3. Each of the options of Plan 5 was combined with the clearing and snagging measure of Plan 3A to form Plans 9A, 9B, 9C, and 9D. Plan 9A involved adding two 10- by 10-foot floodgates adjacent to the two existing 10- by 10-foot floodgates. Plan 9B involved the addition of four 10- by 10-foot floodgates and Plan 9C involved the addition of six 10- by 10-foot floodgates. A fourth option, Plan 9D, involved adding 8 more 10- by 10-foot floodgates adjacent to the existing structure. The description of the floodgates and impacts of Plan 5 are applicable to this plan. The 60 miles of channel clearing and snagging proposed for Plan 3A are also proposed for this plan. Combining the two measures does not alter the enviromental impacts of clearing and snagging. The additional gates affect 20 acres and the clearing and snagging affects 1,124 acres. The environmental construction impacts of the plan result essentially from the clearing and snagging component. The cost of Plan 9A was estimated at $8.0 million, the cost of Plan 9B was $9.3 million, the cost of 9C was $10.5 million, and the cost of 9D was $11.6 million. To assess the economic feasibility of the concept of Plan 9, the option 9B was evaluated. Based on the analysis, without-project average annual acres flooded could be reduced by 56 percent and would result in intensified agriculture use on an estimated 23,845 acres. Total average annual inundation reduction and intensification benefits would be $1,126,000. The annual charges of this plan would be $980,000, resulting in a B/C ratio of 1.15. The B/C ratio for Plan 9B appears positive, but it does not include mitigation costs. While the mitigation plans were not finalized, the least costly mitigation plan was $2.3 million. Adding $2.3 million to the cost side of Plan 9B would bring the B/C ratio down to 0.9. Plans 9A, 9C, and 9D would also have the same mitigation requirements and would be marginal at best. Throughout the study period, local residents have advanced the concept of additional floodgates plus channel modification as an acceptable alternative. In an attempt to give upstream channel improvements every

possible opportunity for inclusion in a final plan, three additional alternatives were formulated and tested in this phase. Three of the plans involved incremental clearing and snagging and the third selective clearing and snagging. Plan 9B1 would consist of four 10- by 10-foot floodgates and clearing of one-third of the major streams in the floodplain. In Plan 9B1, Bayou Rigolette would be cleared and snagged. Plan 9B2 would consist of four 10- by 10-foot floodgates with two-thirds clearing. In Plan 9B2, all major streams except Bayous DuGrappe and Sugarhouse would be cleared. Plan 9B3 would include a four-culvert floodgate and clearing and snagging of all major streams in the flood plain including Bayous DuGrappe and Sugarhouse. Plan 9B4 would consist of four additional culverts and selective clearing and snagging of the entire 60 miles of major streams in the flood plain. Selective clearing involves removal of stream obstruction and overhanging trees. In the analysis of 9B1 thru 9B4, Plan 9B3 emerged as the most efficient with the highest B/C ratio. However, when mitigation cost was included, the B/C ratio was less than 1.

A.2.45. In summary, the analysis indicates that while this plan would probably be acceptable to the public, it would only be marginally feasible at best. The attempts to include upper stream improvements were considered environmentally harmful, requiring costly mitigation. The plan is not the most efficient means of evacuating floodwater from the basin and was eliminated from further study.

PLAN 19 - BAYOU RIGOLETTE FLOODGATES AND FEE ACQUISITION OR EASEMENT

A.2.46. This plan combines the floodgates described in Plan 5 with fee acquisition or easement acquisition over those lands subject to flooding when the floodgates are closed. The description of the floodgates, the benefits, and the impacts of Plan 5 are fully applicable to this plan. The concept of acquisition and easement presumed two conditions would occur: additional wooded lands in the floodprone area would be cleared if a flood control plan were implemented, and future flood damages could be limited by restricting land uses incompatible with the flood hazard of the area. It

was determined that approximately 30,800 acres would flood if a 3-year event occurred when the floodgates were closed. To acquire any rights over this much land, largely cropland, and remove it from production would be unacceptable to the public, counterproductive to the national economy, and contrary to the NED objective. When closed, the additional floodgates would not change the extent or frequency of flooding that now occurs under existing conditions. Consequently, the Federal government would have no obligation to acquire any rights because this project alternative would cause no injury to the landowners. Accordingly, no public purpose would be served by fee acquisition or easement for a closed gate scenario.

A.2.47. To retain a nonstructural component that aptly addresses the study planning objectives, this plan was reformulated. In cooperation with the U.S. Fish and Wildlife Service, the concept of a "no-development easement" was explored as a means of perserving bottomland hardwoods and preventing flood damages on lands cleared in the future. Induced clearing was considered a possibility becasue of past experiences with other agricultural projects, namely McKinney Bayou and Posten Bayou. Studies have indicated that both of these projects were expected to induce clearing. The easement would be acquired over all wooded lands within the with-project 5-year overflow area. The environmental restrictions associated with this type of easement would prohibit the conversion of woodlands to other uses and provide control over timber harvesting.

A.2.48. For each of the three plan options an estimate was made of the wooded lands that would be affected. Plan 19A would require an easement over 3,198 acres, Plan 19B requires 2,200 acres, and Plan 19C requires 1,983 acres. The overall cost (including the floodgates) is estimated to be $6.4 million for Plan 19A, $7.0 million for Plan 19B, and $8.1 million for Plan 19C. The benefits of these plans are the same as achieved with the options of Plan 5. To access the economic feasibility, the costs of Plan 19B were compared to benefits of 19B/5B ($966,000). Based on annual charges for Plan 19B of $705,000, not including environmental costs, the B/C ratio is 1.4.

A.2.49. Plan 19 is a viable solution to the basin problems. It conbines effective flood reducing measures while protecting the environment. Further study of this plan is warranted.

PLAN 20 - PUMPING STATION

A.2.50. This plan provides for installation of a pumping station near the existing Bayou Rigolette structure (see Figure 6). Options analyzed were a 1,000-cfs, 2,000-cfs, and 3,000-cfs-capacity pumping stations. The pump configurations for each option are given in Table A-2-6. The pumping station would be located approximately 400 feet west of the existing structure and 170 feet from the toe of the landside levee. The inflow channel would be approximately 170 feet long and the outflow channel approximately 1,250 feet long, both with bottom widths of 60 feet. Between the inlet channel of the pumping station and the existing channel, a rock dike is necessary to prevent turbulent flow between the two structures. The rights-of-way required for all options were estimated to be 18 acres. The cost of Plan 20A was estimated to be $24.7 million, Plan 20B was $35.4 million, and Plan 20C was $49.4 million.

TABLE A-2-6

PLAN 20 - PUMP CONFIGURATION

Options	Capacity (cfs)	Pump Configuration	Excavation Quantity (cu. yd.)
A	1,000	5-200 cfs pumps	102,000
B	2,000	5-400 cfs pumps	120,000
C	3,000	8-375 cfs pumps	123,000

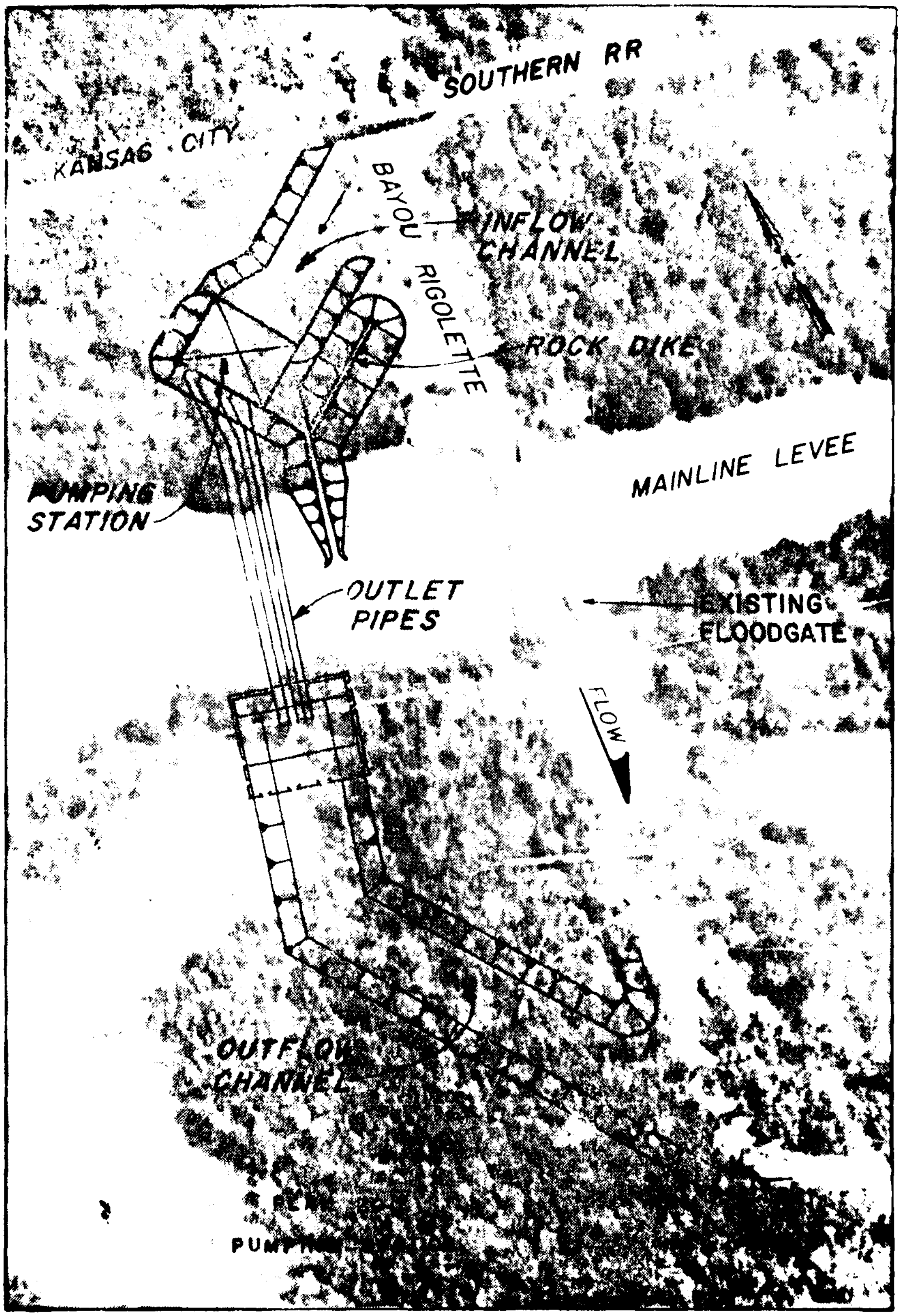

KANSAS CITY
SOUTHERN RR
BAYOU RIGOLETTE
INFLOW CHANNEL
ROCK DIKE
MAINLINE LEVEE
PUMPING STATION
OUTLET PIPES
EXISTING FLOODGATE
FLOW
OUTFLOW CHANNEL

FIGURE 6

A.2.51. To determine whether use of a pumping station was economically feasible, Plan 20B was evaluated. The pumping station was operated so that the 400-cfs pumps were started one by one as needed to pump approximately one half the flow of Bayou Darrow. Based on the hydraulic and economic studies, this plan was estimated to reduce the average annual acres flooded by 65 percent. The average annual damage reduction and intensification benefits were computed to be $678,000. The annual charges for this plan are $3,999.000 and the B/C ratio is 0.15. It is reasonable to assume that further development of the pumping station concept would not be feasible. Further study of this plan was not warranted.

PLAN 21 - "NO ACTION" ALTERNATIVE

A.2.52. Without flood control improvements within the Aloha-Rigolette alluvial flood plain, the flood damages to agricultural activities are expected to continue. The current crop distribution, which has been determined largely by economic factors, is expected to continue in the future. The high moisture content of the soil and the frequent flooding will continue to produce reduced crop yeilds. Further clearing of woodlands for agricultural activities is expected to be minimal without flood control improvements. No significant increases in acres flooded or damaged are expected in the future. This plan is not acceptable to basin residents but was retained for comparative purposes.

PLAN 22 - "NO STRUCTURE" PLAN

A.2.53. As noted, the Bayou Rigolette floodgates have been closed to prevent backwater flooding from the Red River just 4 times in the 29 years of existence: 1957, 1958, 1966, and 1973. Some planners considered that if the floodgates function so infrequently, they may not be needed at all. Therefore, a plan was analyzed that actually represents a "no structure" alternative. For planning purposes, this plan would consist of removal of the existing structure at the Red River, leaving a gap in the levee. The gap would be sized so as to convey the Bayou Rigolette design flow without

causing flooding along Bayous Rigolette and Du Grappe. The plan would allow free discharge of Bayou Rigolette, Red River permitting, and free access of the Red River to the Bayou Rigolette Basin. Plate C-24 of the Engineering Investigations Appendix shows that the plan would produce unreasonable induced flooding, as much as 7 feet higher for the 100-year-frequency event.

A.2.54. Plate C-24 shows that stages in the vicinity of the Pineville gage would be 77, 82, and 90 feet for return of the 5-, 25-, and 100-year-frequency floods, respectively. Under this condition, 6,200, 24,000, and in excess of 36,500 acres of cleared land in the Bayou Rigolette Basin would be flooded during a return of the 5-, 25-, or 100- year-frequency floods, respectively. The 100-year-frequency flood would produce a stage in the basin 1.7 feet in excess of the maximum stages of record and 77 percent of the cleared land in the basin would be flooded. Detailed benefits and costs were not computed because the plan would obviously be unacceptable to local residents.

PLANS SELECTED FOR DETAILED STUDIES

A.2.55. As a result of the assessment and evaluation studies, Plans 3, 9, 20, 21, and the "no-structure" alternative were eliminated from further consideration. Plans 5, 6, and 19 were retained for further study.

SECTION 3. DETAILED PLAN ANALYSIS

A.3.1. The objective of this phase was to determine the optimum configuration for Plans 5, 6, and 19, and to tentatively select a plan for implementation. In this section, each plan is further assessed and evaluated in terms of economic, social, and environmental impacts. Environmental measures are incorporated into each plan to address unavoidable adverse impacts. The degree to which the plans meet the planning objectives is determined. The trade-off analysis between plans is described and the rationale for the tentatively selected plan is given.

DETAILED ASSESSMENT

DEVELOPMENT OF DETAILED PLANS

A.3.2. The pertinent data on Plans 5, 6, and 19 presented in the intermediate phase were not changed during detailed studies. The initial task in this phase was to develop a mitigation plan to offset the unavoidable adverse impacts and to incorporate the environmental costs and benefits into these plans. No recreational features were incorporated into any plan because the available recreational resources and opportunities adjacent to and outside the alluvial plain exceeded the area needs. After including all necessary components, each option developed in the intermediate phase was again evaluated.

MITIGATION PLANNING

A.3.3. The Federal objective of water and related land resources project planning is to contribute to national economic development in a manner consistent with protecting the nation's environment. Intangible and nonmonetary environmental quality values associated with fish and wildlife

TABLE A-3-1

PLANS FOR DETAILED STUDY

Aloha-Rigolette Area

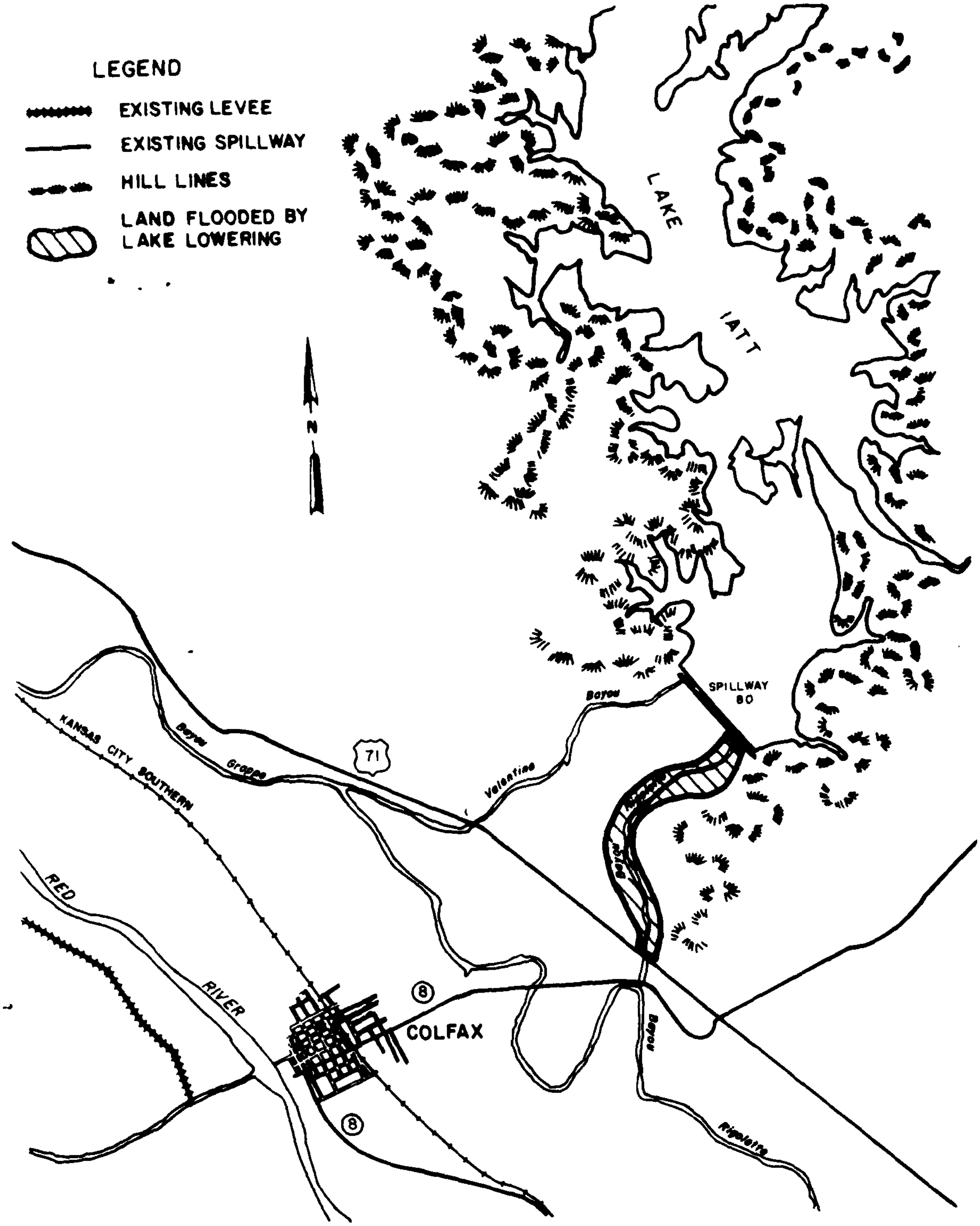
	Plan Options										
	Floodgates at Bayou Rigolette				Floodgates at Bayou Darrow and Channel Modification				Floodgates at Bayou Rigolette and no-development easement		
	5A	5B	5C	5D	6A	6B	6C	6D	19A	19B	19C
No. of Floodgates 1/	2	4	6	8	4	5	6	7	2	4	6
Size of Floodgates	----------	----------	----------	----------	----------	10' x 10'	----------	----------	----------	----------	----------
Miles of Clearing and Snagging					12.4	12.4	23.2	23.2			
Miles of Channel Enlargement					10.8	10.8					
Acres of "No-development" Easements									3,178	2,181	1,963
Total Acres Affected	20	20	20	20	526 2/	483 2/	462 2/	462 2/	3,198	2,201	1,983

1/ The number of floodgates shown is in addition to the two existing floodgates at Bayou Rigolette.

2/ Includes 160 acres of riparian habitat not included in real estate estimate.

resources and habitat are important elements in the environment. Where unavoidable adverse environmental impacts would result, various mitigation measures were considered.

A.3.4. The floodgates in Plans 5 and 19 were estimated to affect approximately 20 acres of a non-unique habitat type. Eleven acres of woodlands would be affected by direct construction and 9 acres, 2 of which are existing borrow pits, would serve as temporary construction easement. After construction is completed, 13 acres would revert to the original state, 2 acres would be converted from open water to terrestrial habitat, and 5 acres would be permanently changed to an open water area. Additionally, 6 acres of woodlands will be affected due to the construction of a landside berm. The adverse environmental impacts associated with the floodgate feature were determined to be minimal. These plans would not induce the clearing of any bottomland hardwoods for agricultural pursuits. However, the overbank flooding during the fish spawning season is considered significant. To compensate for the loss of spawning opportunity, two mitigation options were explored. The first option was to create a spawning area that could be used on a yearly basis. This option required the construction of both a water control structure and a low levee. The second option, which was less costly and better satisfied the planning objectives, was to facilitate the periodic drawdown of Iatt Lake to help control its aquatic plant growth problem. This option would require the purchase of a flowage easement on 100 acres of woodlands and 70 acres of croplands (see figure 7). Because of the low cost and beneficial impacts on Iatt Lake, the second option was selected for inclusion in Plans 5 and 19. The actual acreages, costs, and benefits for each option of Plans 5 and 19 are:



MITIGATION AREA
FOR PLANS 5A thru 5D & 19A thru 19C

FIGURE 7

MITIGATION FOR PLANS 5 AND 19

Plan	Flowage Easements on Agricultural (Ac)	Flowage Easements on Woodland (Ac)	Annual Cost	Annual Benefits
5A, 5B, 5C, 5D, 19A, 19B and 19C	70	100	$16,000	$74,000

A.3.5. Direct construction impacts of Plan 6 are a result of floodgate construction and channel improvements. Floodgate construction would affect 26 acres of woodlands and 9 acres of croplands. Of these affected acres, approximately 24 acres would develop as altered riparian habitat, 9 acres would revert to cropland, and 2 acres would be permanently changed to open-water area. The adverse environmental impacts associated with the floodgate feature were determined to be minimal and did not warrant development of a mitigation plan.

A.3.6. Significant adverse environmental impacts would, however, be associated with the channel improvement feature of this plan, primarily with the loss of valuable riparian habitat and fishery resources, and with the reduction of overbank flooding during the fish spawning season. To negate some of the adverse impacts to riparian habitat, the acres denuded during the channel improvement work would be replanted with various forbs and grasses that provide food, cover, and shelter for wildlife. The permanency of this action would be interrupted by periodic major maintenance approximately every 12 years. The remaining adverse impacts on fish and wildlife due to channel improvements would have to be offset by mitigation measures. No induced clearing of bottomland hardwoods for agricultural pursuits is anticipated with this plan.

A.3.7. Several mitigation options were evaluated to offset the remaining environmental damages due to the clearing and snagging and the channel excavation features of this plan. The first mitigation option considered involved the establishment of in-kind habitat. This would be accomplished

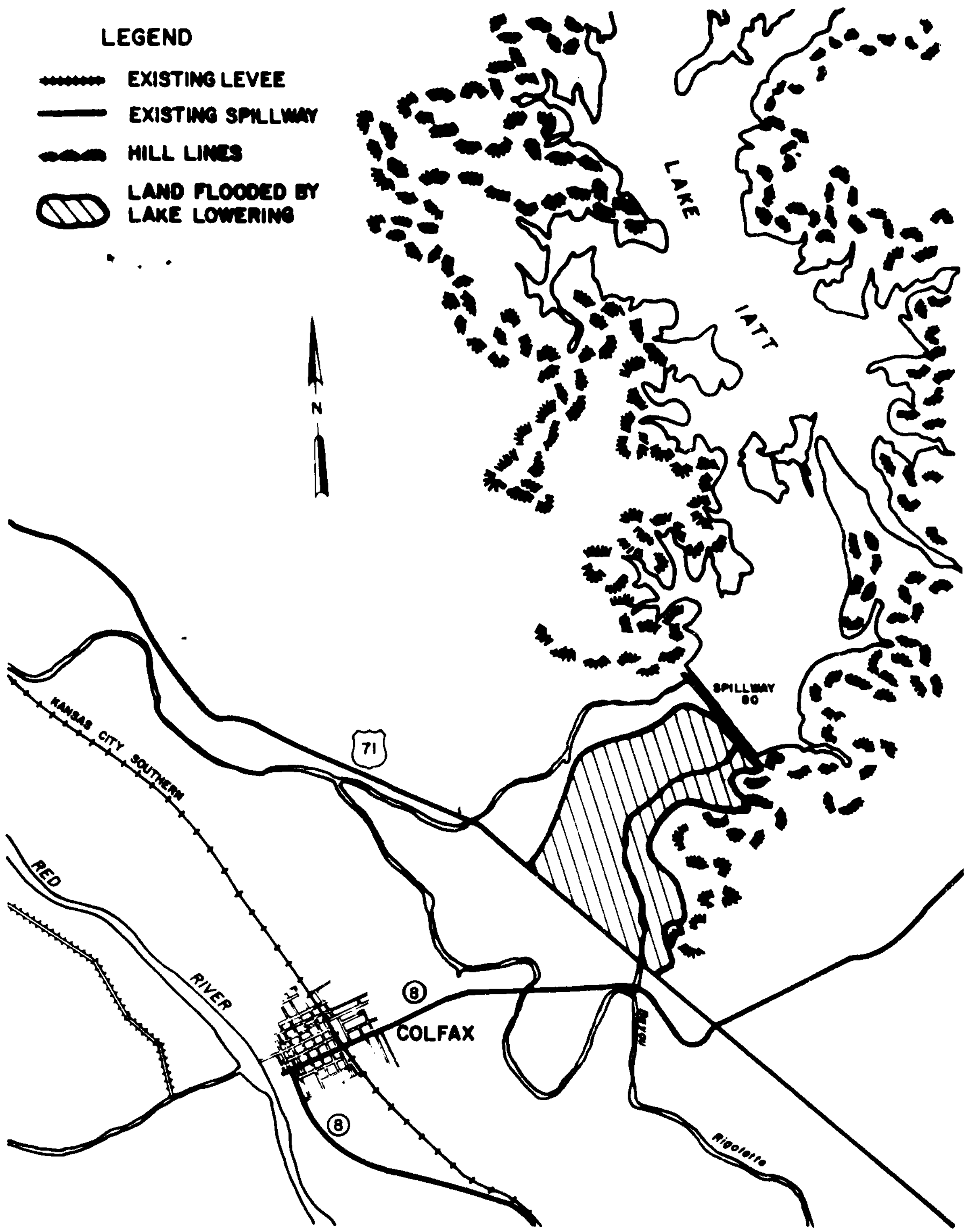
by purchasing a no-development easement and reforestation of agricultural lands adjacent to and, for the most part, within the affected riparian area. In conjunction with this would be the purchase of flowage easements on all lands subject to flooding by the drawdown of Iatt Lake. This mitigation option would allow for the establishment of altered riparian habitat and would facilitate the lowering of Iatt Lake to increase its fishery resource. It was determined, however, that the purchase and reforestation of agricultural lands within the affected riparian area would result in non-contiguous tracts that would be considered unmanageable. Therefore, this option was excluded from further consideration.

A.3.8. The second mitigation option investigated, and the option recommended for implementation should Plan 6 be implemented, consists of the purchase in fee and reforestation of between 705 and 615 acres of agricultural lands, depending on the option considered, and the acquition of a flowage easement on about 100 acres of woodlands. (See Figure 8.) Both of these areas are subject to flooding with the drawdown of Iatt Lake. This mitigation option would fully compensate for project losses by creating suitable wildlife habitat and by substantially increasing the fishery resources in Iatt Lake. The actual acreages, costs and benefits of each Plan 6 option are shown below:

MITIGATION FOR PLAN 6

Plan	Agriculture lands purchased in fee (A)	Flowage easements on woodland (A)	Annual Costs	Annual Benefits
6A	705	100	$145,000	$81,000
6B	645	100	134,000	81,000
6C	615	100	128,000	81,000
6D	615	100	128,000	81,000

A.3.9. Mitigation measures excluded from detailed consideration included the purchase and management of bottomland hardwoods that presently exist in the study area to compensate for the riparian habitat losses. This option was eliminated because all the existing bottomland hardwoods are expected



MITIGATION AREA
FOR PLANS 6A, 6B, 6C & 6D

FIGURE 8

to remain in the future with the project. Most of the larger tracts are currently being managed for wildlife production, primarily deer. Therefore, no preservation or management credit could be accrued due to their purchase as separable mitigation lands.

A.3.10. Compensating for project impacts by providing funding to other Federal and state agencies (USFS, FWS, and LDWF) for the management of their existing lands was considered. This assumes that such lands are uneffectively managed and thus are below their reasonably obtainable wildlife potential. This approach also assumes that public use of these lands could be greatly increased in response to increased wildlife potential. Area public lands are already fully dedicated to specific management goals. National forests are administered under a concept of multiple use, National Wildlife Refuges emphasize protection of wildlife resources, and State Wildlife Management Areas empha ize wildlife productivity and public use. Public use of National Wildlife Refuges, as well as national forests, is being given more emphasis than ever before. Some state lands are approaching a condition where it will be difficult to provide additional public use and still protect habitat and wildlife values. State agencies are acutely aware of the need to acquire additional public wildlife lands to meet the increasing recreational demand. Each of the public land management agencies have sources of management funding. If available funding is inadequate, there are established sources through which the situation can be rectified. Given the tremendous increase in public demand for wildlife areas and the ever-decreasing availability of private wildlife lands, we envision that wildlife management of existing public wildlife areas and national forests in the project vicinity will be adequately funded in the future. Therefore, providing project (mitigation) funds to accomplish that which would be accomplished via established and proper sources would have no net positive impact upon wildlife values. These comments on compensating for project impacts by providing funding to other Federal and state agencies are from the U.S. Fish and Wildlife Service Draft Coordination Act Report for the Aloha-Rigolette Area, dated March 1984.

BIOLOGICAL AND WATER QUALITY IMPACTS

A.3.11. Implementation of any option of Plans 5 or 19 would result in significant adverse environmental impacts because of the reduction in overbank flooding during fish spawning season. Implementation would also result in only slight adverse biological impacts. These impacts would be primarily associated with the minimal loss of 18 acres of forested habitat and 2 acres of open water (15 acres would become altered riparian habitat and 5 acres open water) and the reduction of flooding during the waterfowl wintering period. This plan would, however, increase the fishery resources by creation of the inflow and outflow channels and by facilitating the periodic drawdown of Iatt Lake. Water quality impacts of the plan would generally be short term and confined to the period during the construction phase. Increased application of pesticides, herbicides, and fertilizers would be expected due to an increase of double cropping of soybeans and wheat. This could degrade water quality. Temporary increases in turbidity and lowered dissolved oxygen may occur in the immediate vicinity of the existing floodgates and for a short distance downstream. When the project is complete, elevated water quality parameters should return to pre-construction levels.

A.3.12. Implementation of any option of Plan 6 would result in significant adverse impacts due primarily to the channel improvement features and the reduction of overbank flooding during spawning season. Impacts associated with the floodgate feature of this plan and subsequent reduction of flooding are similar to the impacts of Plans 5 and 19. However, the increased use of pesticides, herbicides, and fertilizers is expected to be slightly greater with Plan 6. Adverse impacts of channel improvements can be divided into those affecting terrestrial resources and those affecting aquatic resoures. Impacts associated with terrestrial resources center around the clearing of approximately 490 acres of riparian habitat that are highly valuable for wildlife. The adverse impacts on aquatic resources are associated with the removal of in-stream cover. Riparian vegetation provides food and cover for fish and shades the water from solar

radiation. Water quality impacts of Plan 6 will occur during construction and for several years until the channel banks revegetate. With clearing and snagging, sediments, pesticides, nutrients, and heavy metals would be resuspended in the water column. Low dissolved oxygen can be anticipated as a result of the increases in turbidity and nutrients. Light penetration would also be reduced. Water temperature in creeks and bayous should fluctuate over a wider range as a result of the loss of streamside cover and its insulation effects. Stream bank erosion could occur during construction and after the project is complete until the banks revegetate. In summary, the combination of instream cover losses, tubidity increases, and dissolved oxygen decreases would result in adverse impacts on fishery resources.

CULTURAL RESOURCES IMPACTS

A.3.13. There are presently no recorded sites or National Register of Historic Places properties on acreage to be affected by Plans 5, 6, and 19. However, sensitive cultural areas are definable based upon interpretation of historic records and basin geomorphology. Potentially sensitive areas that warrant particular investigation in order to fully inventory sites are the floodgate locations for Plans 5 and 19, Plan 6 channel modification and clearing and snagging easements along Sam Bayou and Bayou Rigolette, the Plan 6 floodgate location (adjacent to the 19th century Thornbush Plantation) and Bayou Rigolette closure (within the boundaries of the early 19th century Bynum Planation). Seasonal raising and lowering of Iatt Lake in mitigation of Plan 6 is expected to accelerate erosion of shoreline prehistoric litric scatters and mound sites. There are six such sites presently known (16 6R2, 5, 6, 7, 11 and 12) adjacent to the Iatt Lake bankline and the likelihood of more being there very high.

RECREATION IMPACTS

A.3.14. Recreational hunting impacts associated with implementation of Plans 5 and 19 would be minimal. Construction of the floodgates would convert 18 acres of existing forest habitat and 2 acres of existing borrow

pit terrestrial habitat and 5 acres of open water. This transfer of land use would slightly reduce potential man-days of hunting. In the existing without-project condition, there are 60,600 annual man-days of hunting and fishing. With these plans, there will be 60,560 annual man-days, representing a reduction of 40 man-days, which corresponds to a $1,000 annual loss. Impacts on potential man-days of recreational fishing because of the reduction of overbank flooding during fish spawning season are potentially great and without a good deal of research these impacts could not be quantified. To compensate for the fishery habitat loss, Iatt Lake would be rejuvenated by management techniques, including periodic lowering of the lake. This lowering would flood about 100 acres of woodlands and 70 acres of croplands. Based upon limited access to the lake and competitive fishing areas in the region, an increase in man-days of fishing is not expected. However, the quality of fishing would be greatly enhanced by the elimination of the aquatic weeds and an increase in the fish population. There are currently an estimated 45,000 annual man-days of fishing at Iatt Lake with an annual value of $147,000. With improved conditions due to drawdowns, the quality and value of the experience would increase to $221,000, a $74,000 increase over the base condition. The total benefits attributible to the mitigation measure for Plans 5 and 19 is $74,000.

A.3.15. With implementation of Plan 6, a total of 517 hunting acres and 25 miles of fishing stream would be affected. Development of this plan would reduce annual man-days of hunting by 450 from the existing condition. The estimated annual dollar value of the reduction is $4,000. Adverse impacts of clearing and snagging on potential sport fisheries were quantified. Based on the disruption of clearing and snagging to the fisheries resource, the annual potential loss is estimated to be 10,000 man-days, valued at $32,000. Combined losses to fishing and hunting total 10,450 man-days with an associated dollar value of $36,000.

A.3.16. To compensate for the hunting, fishing, and habitat losses, a mitigation plan was formulated. To compensate for the riparian loss, between 705 and 615 acres of agricultural land would be acquired in fee, depending on the plan option considered. This land would be managed and converted into a forested area, part of which would be periodically flooded by the lowering of Iatt Lake. An annual potential for 180 man-days of waterfowl hunting, 270 man-days of large game hunting, and 320 man-days of small game hunting with a total value of $7,000 will be created with this plan.

A.3.17. In order to compensate for the fisheries loss, including the reduction of spawning area, Iatt Lake will be rejuvenated by management techniques such as periodic lowering of the lake. This lowering will flood the agricultural land previously mentioned. Based on limited access to the lake and competitive fishing areas in the region, an increase in man-days of fishing is not expected. However, the quality of fishing will be greatly enhanced by the elimination of the aquatic weeds and an increase in the fish population. There are currently an estimated 45,000 annual man-days of fishing with an annual value of $147,000. With improved conditions due to draw-downs, the quality and value of the experience would increase to $221,000, a $74,000 increase over the base condition. Total benefits of the mitigation plan would be $81,000.

ECONOMIC IMPACTS

A.3.18. The economic impacts of alternative Plans 5A through 5D, 6A through 6D, and 19A through 19C are discussed in detail in Appendix D, Economic Analysis. The construction costs, average annual costs, average annual benefits, and benefit cost ratios for all options are summarized in Table A-3-2.

EVALUATION OF PLANS

FULFILLMENT OF PLANNING OBJECTIVES

A.3.19. The specific planning objectives that guided the formulation of plans to address water resource problems in the Aloha-Rigolette area are described in Section 2 of this appendix. Table A-3-3 presents a summary of the contribution of each plan to the study planning objectives.

A.3.20. Contributions in Table A-3-3 are categorized as beneficial (+) or adverse (-). The magnitude of the contribution is rated as high (H), medium (M), or low (L). These ratings are intended to distinguish degrees of difference among the alternative plans and options and are not absolute levels of accomplishment. The contributions are rated relative to each other and to the without-project conditions.

SYSTEM OF ACCOUNTS

A.3.21. The significant impacts of each plan are evaluated to establish the contributions of each plan to National Economic Development (NED), Environmental Quality (EQ), Regional Development (RD), and Social Well-Being (SWB). The plan's impacts on these four accounts are displayed in the system of accounts Table A-3-4.

TRADE-OFF ANALYSIS

A.3.22. The information presented in the systems of accounts provides the basic framework for the trade-off analysis. Contributions to NED benefits are only a part of the trade-off analysis. Other aspects involve the quantitative information on the social and environmental values of each plan. The plan with the greatest net economic benefits consistent with protecting the nation's environment is selected unless deviation is justified on the basis of trading-off contributions of the other plans.

TABLE A-3-2

ECONOMIC IMPACTS OF PLANS

1985 Prices/8-3/8 Percent
($000)

	Plans										
	Floodgates at Bayou Rigolette				Floodgates at Bayou Darrow and Channel Modification				Floodgates at Bayou Rigolette and "no-development easement		
	5A	5B	5C	5D	6A 1/	6B 1/	6C 1/	6D 1/	19A	19B	19C
Total First Cost 2/	$4,500	$5,700	$6,900	$8,120	$13,320	$12,580	$12,200	$13,200	$6,480	$7,080	$8,180
Average Annual Cost	474	577	731	846	1,467	1,414	1,370	1,481	646	722	860
Average Annual Benefits	844	1041	1,225	1,317	1,798	1,785	1,749	1,749	844	1,041	1,225
Damage Reduction											
Crop	535	686	833	906	1,249	1,240	1,217	1,217	535	686	833
Non-Crop	96	100	102	103	105	105	104	104	96	100	102
Intensification	139	181	216	234	363	359	347	347	139	181	216
Mitigation	74	74	74	74	81	81	81	81	74	74	74
Net Economic Benefits	370	464	494	471	331	371	379	268	198	315	365
Benefit—Cost Ratio	1.8	1.8	1.7	1.6	1.2	1.3	1.3	1.2	1.3	1.4	1.4

1/ Includes mitigation as follows: Plan 6A - $1,720,000, Plan 6B - $1,580,000, and Plans 6C and 6D - $1,500,000.

2/ Does not include preauthorization study cost of $845,000.

TABLE A-3-3

FULFILLMENT OF PLANNING OBJECTIVES

Objectives	Floodgates at Bayou Rigolette				Floodgates at Bayou Darrow and Channel Modification				Floodgates at Bayou Rigolette and no-development easement		
	5A	5B	5C	5D	6A	6B	6C	6D	19A	19B	19C
Reduced flood losses	L+	M+	M+	M+	H+	H+	H+	H+	L+	M+	M+
Avoid destruction of bottomland hardwoods and wetlands	H+	H+	H+	H+	L+	L+	L+	L+	H+	H+	H+
Minimize adverse environmental impacts associated with flood control improvements	H+	H+	H+	H+	L+	L+	L+	L+	H+	H+	H+
Avoid destruction of archeological, historical, and paleontological resources	H+	H+	H+	H+	L+	L+	L+	L+	H+	H+	H+

TABLE A-3-4

SYSTEM OF ACCOUNTS

(Plan 5)

Account	Indices 1/	Plan 5A	Plan 5B	Plan 5C	Plan 5D
		Options			
I. PLAN DESCRIPTION		Install 2-10' x 10' vertical lift flood-gates on Bayou Rigolette with 680 ft. inflow channel and 1,010 ft. outflow channel.	Install 4-10' x 10' vertical lift flood-gates on Bayou Rigolette with channels same as 5A.	Install 6-10' x 10' vertical lift flood-gates on Bayou Rigolette with channels same as 5A.	Install 8-10' x 10' vertical lift flood-gates on Bayou Rigolette with channels same as 5A.
II. NATIONAL ECONOMIC DEVELOPMENT					
A. Total average annual benefits ($000)		$ 844.0	$ 1,041.0	$ 1,225.0	$ 1,317.0
1. Crop damage reduction	2, 6, 9	535.0	686.0	833.0	906.0
2. Non crop damage reduction	2, 6, 9	96.0	100.0	102.0	103.0
3. Intensification	2, 6, 9	139.0	181.0	216.0	234.0
4. Mitigation		74.0	74.0	74.0	74.0
B. Total average annual costs ($000)		$ 474.0	$ 577.0	$ 731.0	$ 846.0
1. Interest and amortization	1, 6, 9	420.0	516.0	664.0	773.0
2. Operation and maintenance	2-3, 6, 9	6.0	13.0	19.0	25.0
3. On-farm drainage	2-3, 6, 9	31.0	31.0	31.0	31.0
4. Environmental losses					
a. Fish & Wildlife losses	-	1.0	1.0	1.0	1.0
b. Agricultural losses	-	-	-	-	-
5. Mitigation interest & amortization & O&M		16.0	16.0	16.0	16.0
C. Total project first costs	1, 6, 9	$ 4,500.0	$ 5,700.0	$ 6,900.0	$ 8,120.0
1. Federal first cost 2/	-	4,486.8	5,686.8	6,886.8	8,106.8
2. Non-Federal first cost 2/	-	13.2	13.2	13.2	13.2
D. 4. Net annual NED benefits	2-3, 6, 9	$ 401.0	$ 464.0	$ 494.0	$ 471.0
E. Benefit-cost ratio	-	1.8	1.7	1.7	1.6

TABLE A-3-4 (Continued)

SYSTEM OF ACCOUNTS

(Plan 5)

Account	Indices 1/	Options: Plan 5A	Plan 5B	Plan 5C	Plan 5D
III. ENVIRONMENTAL QUALITY					
A. Wetlands		Reduced flooding will adversely affect spawning.			
B. Water quality*	1, 6, 9	Minor impacts - Short term water quality impacts during construction confined to vicinity of floodgate. Temporary increases in turbidity and decreases in dissolved oxygen. Increase application of pesticides, herbicides, and fertilizers due to increased cropping of soybeans and wheat.			
C. Endangered & threatened species	-	---No Effect---			
D. Fish and wildlife habitat					
1. Terrestrial	2, 5, 9	20 acres of forested habitat would be adversely affected. Of this, 15 acres would revert to forest woodlands and 5 acres would be permanently converted to open water. 40 man-days of hunting with an estimated value of $1,000 would be lost.			
2. Aquatic	2, 6, 9	Aquatic habitat would be increased by 5 acres. Fish spawning will be reduced.			
E. Historic and cultural properties	-	No impact on sites listed or eligible for listing in the National Register of Historical Places. Identified cultural resources in the study area would not be affected. The probability of finding buried ship wreckage is unknown.			
F. Prime farmland	2, 6, 9	Opportunity created to increase annual productivity on 22,066 acres, used mostly for soybeans.	Opportunity created to increase annual productivity on 22,566 acres, used mostly for soybeans.	Opportunity created to increase annual productivity on 22,691 acres, used mostly for soybeans.	Opportunity created to increase annual productivity on 22,883 acres, used mostly for soybeans.
G. Air quality*	1, 6, 9	---Minor short term impacts during construction.---			
H. Flood plains (cleared area)	2, 6, 9	Reduce average annual acres flooded by 34%.	Reduce average annual acres flooded by 41%.	Reduce average annual acres flooded by 49%.	Reduce average annual acres flooded by 53%.
	-	---No project related induced clearing is expected.---			
I. Wild and scenic rivers	-	---Not present in planning area.---			

TABLE A-3-4 (Continued)

SYSTEM OF ACCOUNTS

(Plan 5)

Account	Indices 1/	Options: Plan 5A	Plan 5B	Plan 5C	Plan 5D
IV. REGIONAL ECONOMIC DEVELOPMENT	2, 5, 10				
A. Regional income and employment	-	Minor gains in employment through increased production and project implementation. Modest increase in income as a result of increased production potential.			
B. Regional growth and business activity	-	Modest increase in agriculture related businesses due to reduction in flood threat and concomitant increased production potential.			
C. Tax revenue*	-	Moderate gains due to higher farm procerty values and increase products sold.			
D. Property value*	-	Modest gains due to lowering of flood threat.			
V. OTHER SOCIAL EFFECTS					
A. Urban and community impacts	-	----None----			
B. Life, health and safety	1-2, 6, 9	The probability of loss of life, property and essential services due to failure is low. The risk of flooding is significantly reduced for storms occurring more frequently than every 5 years.			
C. Displacement	-	----None----			
D. Long-term productivity	2-3, 5, 9	No affect on permanency of agricultural activities in basin. Modest gains in agricultural productivity as a result of intensified use on existing agricultural lands.			
E. Leisure	-	----No effect.----			
F. Esthetis*	1, 6, 9	No significant long-term effect. Temporary adverse visual impacts during construction.			
G. Community cohesion	Preserves traditional agricultural lifestyle.				
H. Community growth*	2, 5, 9	Minor beneficial impact on community growth through increased productivity made possible by reduction in flood stages.			
I. Transportation	-	----No effect.----			
J. Noise	1, 6, 9	Minor increase in noise level during construction.			
K. Quality of life	2-3, 5, 9	Reduction in flood stages would substantially improve quality of life for farmers who not experience frequent flooding.			

TABLE A-3-4 (Continued)

SYSTEM OF ACCOUNTS

(Plan 6)

Account	Indices 1/	Options: Plan 6A	Options: Plan 6B	Options: Plan 6C	Options: Plan 6D
I. PLAN DESCRIPTION		Install 4-10' x 10' vertical lift flood-gates on Bayou Darrow with 12.4 miles of channel cleared and snagged and 10.8 miles of enlargement.	Install 5-10' x 10' vertical lift flood-gates on Bayou Darrow with 12.4 miles of channel cleared and snagged and 10.8 miles of enlargement of lesser scope than Plan 6A.	Install 6-10' x 10' vertical lift flood-gates on Bayou Darrow with 23.2 miles of channel cleared and snagged.	Install 7-10' x 10' vertical lift floodgates on Bayou Darrow with 23.2 miles of channel cleared and snagged.
II. NATIONAL ECONOMIC DEVELOPMENT					
A. Total average annual benefits ($000)		$ 1,798.0	$ 1,785.0	$ 1,749.0	$ 1,749.0
1. Crop damage reduction		1,249.0	1,240.0	1,217.0	1,217.0
2. Non crop damage reduction		105.0	105.0	104.0	104.0
3. Intensification		363.0	359.0	347.0	347.0
4. Mitigation		81.0	81.0	81.0	81.0
B. Total average annual costs ($000)		$ 1,467.0	$ 1,414.0	$ 1,370.0	$ 1,481.0
1. Interest and amortization		1,216.0	1,165.0	1,124.0	1,229.0
2. Operation and maintenance		39.0	48.0	51.0	57.0
3. On-farm drainage		31.0	31.0	31.0	31.0
4. Environmental losses					
a. Fish & Wildlife losses		36.0	36.0	36.0	36.0
b. Agricultural losses		74.0	-	-	
5. Mitigation: interest, amortization & O&M		145.0	134.0	128.0	128.0
C. Total project first costs		$13,320.0	$12,580.0	$12,200.0	$13,200.0
1. Federal first cost 2/		12,768.0	12,094.0	11,784.0	12,787.0
2. Non-Federal first cost 2/		552.0	486.0	416.0	413.0
D. 4. Net annual NED benefits		$ 305.0	$ 342.0	$ 350.0	$ 247.0
E. Benefit-cost ratio		1.2	1.3	1.3	1.2

TABLE A-3-4 (Continued)

SYSTEM OF ACCOUNTS

(Plan 6)

Account	Indices 1/	Options: Plan 6A	Plan 6B	Plan 6C	Plan 6D
III. ENVIRONMENTAL QUALITY					
A. Wetlands		Some wetlands would be destroyed by clearing and snagging. Although not computed, the affected acreage is expected to be less than 100 acres. Fish spawning would be effected by reduced flooding.			
B. Water quality*		Impacts of the floodgates are as described for Plan 5. major impacts from channel improvements - Occur during construction and for several years until vegetation reestablishes along stream banks. Sediments, pesticides, nutrients, and heavy metals will be resuspended in the water column. Increased turbidity and nutrients will probably lower dissolved oxygen.			
C. Endangered & threatened species		----------Not present in planning area----------			
D. Fish and wildlife habitat					
1. Terrestrial		26 acres of woodlands, 9 acres of cleared, and 491, 448, and 427 acres of riparian habitat, respectfully, would be adversely affected. Combined fishing and hunting loss valued at $36,000.			
2. Aquatic		About 300 acres of aquatic habitat would be impacted by channel improvement works. Reduced flooding would adversely effect fish spawning.			
E. Historic and cultural properties	-	Potentially sensitive areas which warrant particular investigation to fully inventory sites are the floodgate, the channel modification and clearing and snagging easements along Sam Bayou and Bayou Rigolette closure (within the boundaries of the early 19th centry Bynum Plantation). Seasonal raising and lowering of Lake Iatt in mitigation of Plan 6 is expected to accelerrate erosion of shore-line prehistoric lithic scatters and mound sites. There are six such sites presently known (16 6R2, 5, 6, 7, 11, and 12) adjacent to the Lake Iatt bankline and the likelihood of more existing is very high.			
F. Prime farmland	2, 6, 9	Opportunity created to increase annual productivity on 25,186 acres, used mostly for soybeans.	Opportunity created to increase annual productivity on 25,186 acres, used mostly for soybeans.	Opportunity created to increase annual productivity on 24,986 acres, used mostly for soybeans.	Opportunity created to increase annual productivity on 24,986 acres, used mostly for soybeans.
G. Air quality*	1, 6, 9	----------Minor short term impacts during construction----------			
H. Flood plains (cleared area)	2, 6, 9	Reduce average annual acres flooded by 81%	Reduce average annual acres flooded by 81%	Reduce average annual acres flooded by 78%	Reduce average annual acres flooded by 78%
	-	----------No project related induced clearing is expected----------			
I. Wild and scenic rivers		----------Not present in planning area----------			

TABLE A-3-4 (Continued)

SYSTEM OF ACCOUNTS

(Plan 6)

Account	Indices 1/	Options: Plan 6A	Plan 6B	Plan 6C	Plan 6D
IV. REGIONAL ECONOMIC DEVELOPMENT	2, 5, 10				
A. Regional income and employment	-	Same as Plan 5			
B. Regional growth and business activity	-	Same as Plan 5			
C. Tax revenue*	-	Same as Plan 5			
D. Property value*	-	Same as Plan 5			
V. OTHER SOCIAL EFFECTS					
A. Urban and community impacts	-	None			
B. Life, health and safety	1-2, 6, 9	Same as Plan 5 except the risk of flooding is significantly reduced for storms occurring more frequently between 5 and 100 years.			
C. Displacement	-	None			
D. Long-term productivity	2-3, 5, 9	Same as Plan 5			
E. Leisure	-	No effect			
F. Esthetic*	2-3, 5, 9	Esthetic value of area would be adversely affected by channel modification and creating temporary disposal areas.			
G. Community cohesion		Same as Plan 5			
H. Community growth*	2, 5, 9	Same as Plan 5			
I. Transportation	1, 6, 9	Minor disruption to vehicular traffic during channel modification operations.			
J. Noise	1, 6, 9	Same as Plan 5			
K. Quality of life	2-3, 5, 9	Same as Plan 5			

TABLE A-3-4 (Continued)

SYSTEM OF ACCOUNTS

(Plan 19)

Account	Indices 1/	Options: Plan 19A	Options: Plan 19B	Options: Plan 19C
I. PLAN DESCRIPTION		Same as Plan 5A with 3,178 acres of "no-development" easement.	Same as Plan 5B with 2,180 acres of "no-development" easement.	Same as Plan 5C with 1,963 acres of "no-development" easement.
II. NATIONAL ECONOMIC DEVELOPMENT				
A. Total average annual benefits ($000)		$ 844.0	$ 1,041.0	$ 1,225.0
1. Crop damage reduction		535.0	686.0	833.0
2. Non crop damage reduction		96.0	100.0	102.0
3. Intensification		139.0	181.0	216.0
4. Mitigation		74.0	74.0	74.0
B. Total average annual costs ($000)		$ 646.0	$ 722.0	$ 860.0
1. Interest and amortization		592.0	661.0	793.0
2. Operation and maintenance		6.0	13.0	19.0
3. On-farm drainage		31.0	31.0	31.0
4. Environmental losses				
Fish & Wildlife losses		1.0	1.0	1.0
5. Mitigation: Interest, amoritization and O&M		16.0	16.0	16.0
C. Total project first costs		$ 6,480.0	$ 7,080.0	$ 8,180.0
1. Federal first cost 2/		4,410.0	5,657.0	6,899.0
2. Non-Federal first cost 2/		2,070.0	1,423.0	1,281.0
D. 4. Net annual NED benefits		$ 198.0	$ 315.0	$ 365.0
E. Benefit-cost ratio		1.3	1.4	1.4

TABLE A-3-4 (Continued)

SYSTEM OF ACCOUNTS

(Plan 19)

Account	Indices 1/	Options: Plan 19A	Plan 19B	Plan 19C
III. ENVIRONMENTAL QUALITY				
A. Wetlands		Reduced flooding would effect fish spawning.		
B. Water quality*	1, 6, 9	Minor impacts - Short term water quality impacts during construction confined to vicinity of floodgate. Temporary increases in turbidity and decreases in dissolved oxygen. Increase application of pesticides, herbicides, and fertilizers due to increased cropping of soybeans and wheat.		
C. Endangered & threatened species		------------------------Not present in planning area------------------------		
D. Fish and wildlife habitat				
1. Terrestrial	2, 5, 9	20 acres of forested habitat would be adversely affected. Of this, 15 acres would revert to forest woodlands and 5 acres would be permanently converted to open water. 40 man-days of hunting with an estimated value of $1,000 would be lost.		
2. Aquatic	2, 6, 9	Aquatic habitat would be increased by 5 acres. Reduced flooding would effect fish spawning.		
E. Historic and cultural properties	-	--------------------------------Same as Plan 5------------------------ -------		
F. Prime farmland	2, 6, 9	Opportunity created to increase annual productivity on 22,066 acres, used mostly for soybeans.	Opportunity created to increase annual productivity on 22,566 acres, used mostly for soybeans.	Opportunity created to increase annual productivity on 22,691 acres, used mostly for soybeans.
G. Air quality*	1, 6, 9	----------------Minor short term impacts during construction------------------		
H. Flood plains (cleared area)	2, 6, 9	Reduce average annual acres flooded by 34%	Reduce average annual acres flooded by 41%	Reduce average annual acres flooded by 49%
	-	---------------No project related induced clearing is expected---------------		
I. Wild and scenic rivers		------------------------Not present in planning area-------------------------		

SYSTEM OF ACCOUNTS

(Plan 19)

Account	Indices 1/	Options: Plan 19A	Plan 19B	Plan 19C
IV. REGIONAL ECONOMIC DEVELOPMENT	2, 5, 10			
A. Regional income and employment	-	Same as Plan 5		
B. Regional growth and business activity	-	Same as Plan 5		
C. Tax revenue*	-	Same as Plan 5		
D. Property value*	-	Same as Plan 5		
V. OTHER SOCIAL EFFECTS				
A. Urban and community impacts	-	None		
B. Life, health and safety	1-2, 6, 9	Same as Plan 5		
C. Displacement	-	None		
D. Long-term productivity	2-3, 5, 9	Same as Plan 5		
E. Leisure	-	No effect		
F. Esthetic*	2-3, 5, 9	Same as Plan 5		
G. Community cohesion		Same as Plan 5		
H. Community growth*	2, 5, 9	Same as Plan 5		
I. Transportation	1, 6, 9	Minor disruption to vehicular traffic during clearing and snagging operations.		
J. Noise	1, 6, 9	Same as Plan 5		
K. Quality of life	2-3, 5, 9	Same as Plan 5		

*Significant impacts specified in Section 122 of Public Law 91-611.

1/ Timing
1. Expected to occur prior to or during implementation of the plan.
2. Expected within 15 years following plan implementation.
3. Expected in a longer time frame (15 or more years following implementation).

Uncertainty
4. The uncertainty is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertainty is less than 10%.

Exclusivity
7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actuality
9. Will occur with implementation.
10. Will occur only when specific additional actions are carried out during implementation.
11. Will not occur because additonal actions are lacking.

2/ The cost sharing shown is based on the traditional policy for local flood protection project.

A.3.23. Plan 5 and Plan 19 are very similiar and accomplish the same purpose. Both 5 and 19 contain additional floodgates at Bayou Rigolette and Plan 19 contains a feature to offset or migitate any anticipated project induced clearing. Plans 19A, 19B, and 19C contain no-development easements of 3,178, 2,180, and 1,963 acres of land below the 5-year flowline as a means of perserving bottomland hardwoods. The cost of the no-development easements ranges between $1.3 to $2 million dollars. Since studies determined that no induced clearing would occur with any plan considered, the no-development easements are not needed. However, the Plan 19 options still contained the cost of the no-development easements and are undesirable economically. Therefore, they were dropped from further consideration.

A.3.24. Plans 5A through 5D and 6A through 6D would all reduce agricultural flooding in the alluvial plain, though not to the same degree. Floodgates, which were determined to be a necessary component in developing an effective and efficient plan, are contained in all Plan 5 and Plan 6 options. The floodgates in Plan 5 would be located at Bayou Rigolette and the floodgates of Plan 6 would be at Bayou Darrow. The incremental difference in degree of protection between Plans 5 and 6 ranges between 25 and 55 percent. However, the difference in first cost ranges between 38 and 66 percent. Thus, the added increment of protection is obtained at a much higher increment of cost. Net excess benefits are all greater with corresponding options of Plans 5 and 6.

A.3.25. Plan 5A is the least expensive of all plans and is fourth in terms of net benefits. The most expensive is Plan 6A, which is seventh in terms of excess benefits. Plan 5C, approximately $2.4 million more expensive than 5A and approximately $7.4 million less expensive than 6A, provides the greatest excess benefits of all plans. The optimal option of Plan 5 is 5C and the optimal option of Plan 6 is 6C.

A.3.26. The environmental impacts of Plan 6 are far more severe than Plan 5. Plan 5 would affect 20 acres of woodland in construction of the floodgates and reduce fish spawning opportunities by reducing flooding on woodlands. Plans 6A, 6B, 6C, and 6D would affect 441, 448, 427, and 427 acres, respectively, of riparian habitat through channel modifications. Additional impacts include 35 acres (9 cleared) needed for each of the floodgates and reduced fish spawning opportunities because of lowered overbank flooding. The Plan 5 options would require mitigation in the form of acquisition of 170 acres of land and periodic lowering of Iatt Lake. All the Plan 6 options would require the acquisition of between 615 and 705 acres of agricultural lands for reforestation as mitigation of environmental losses. The social impacts of the eight plan options are minimal and are essentially equal. All options are acceptable to local interests.

A.3.27. As noted, the choice of alternative plans is between 5C and 6C. The average annual acres flooded are reduced 49 percent with Plan 5C and 78 percent with Plan 6C. The cost of Plan 5C is $6,900,000 and the cost of Plan 6C is $12,200,000. The environmental impacts are much greater with Plan 6C. Lastly, local interests would support either plan.

NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

A.3.28. The NED plan is defined as the plan that provides the greatest net benefits consistent with protecting the nation's environment. Plan 5C, which provides for installation of six additional floodgates, has the greatest net benefits and is, therefore, the NED plan. The average annual costs are $731,000 and the average annual benefits are $1,225,000, resulting in net economic benefits of $494,000. The benefit cost ratio of Plan 5C is 1.7 to 1.

RATIONALE FOR TENTATIVELY SELECTED PLAN

A.3.29. The options developed for Plan 5 are the most desirable from a national economic development and environmental quality perspective. The options developed for Plan 6 provide a greater degree of protection, but at a disportionate increase in cost. Thus, the selection between Plans 5 and 6 represents a trade-off among cost, degree of protection, and environmental quality.

A.3.30. The two plans most worthy of final consideration are Plan 5C and Plan 6C. Of these, the tentatively selected plan is 5C. This plan has greater excess benefits over cost than Plan 6C and fewer environmental damages. Further, the cost to achieve an additional 45 percent reduction in average annual acres flooded would increase the total cost of the project 87 percent.

SECTION 4 - TENTATIVELY SELECTED PLAN

DESCRIPTION OF PLAN

A.4.1. The tentatively selected plan consists of six additional floodgates installed adjacent to the existing Bayou Rigolette structure. The six gates would each be 10 feet wide and 210 feet long and would be constructed of reinforced concrete. A vertical lift gate would control the flow through each boxed opening. The floodgates would be approximately 600 feet east of the existing structure. An inflow and an outflow channel would convey flow away from Bayou Rigolette just south of the Kansas City Southern Railway. The inflow channel would be 680 feet and the outflow channel 1010 feet. The bottom width would be 100 feet with the channel bank slopes 1V on 3H. The total first cost would be $6,900,000.

DIVISION OF PLAN RESPONSIBILITY

A.4.2. The purpose of this section is to present the division of responsibility for implementation of the tentatively selected plan between Federal and non-Federal interests. The cost apportionment is based on current Federal legislation (traditional policy). The current administration has proposed changes in this policy, favoring greater participation by non-Federal interests. Costs for the tentatively selected plan will be discussed in a manner consistent with approved legislation but will be displayed under the traditional and proposed policy.

COST-SHARING POLICY

A.4.3. Cost-sharing policies for water resources projects under the jurisdiction of the Corps of Engineers have evolved over the years through various acts approved by Congress. Legislative authorization has defined general rules for cost sharing or has prescribed percentages of cost required by non-Federal entities depending on the purpose of the

project. The purpose of the Aloha-Rigolette project is that of local flood protection. The traditional cost-sharing policy for this purpose is that 100 percent of the construction first cost is to be borne by the Federal government and non-Federal interests are required to provide all lands, easements, and rights-of-way, and all alterations and relocations to utilities, streets, bridges (except railroad bridges), buildings, storm drains, and other structures and improvements; to hold and save the United States free of damages due to the construction works; and assure operation and maintenance of the works after completion in accordance with regulations prescribed by the Secretary of the Army.

A.4.4. The present administration is reviewing project cost sharing and financing across the entire spectrum of water resources development and has proposed revised policy. The basic principle governing the development of specific cost-sharing recommendations is that, whenever possible, the cost of services produced by water projects should be paid for by their direct beneficiaries. It is also recognized that the Federal government can no longer bear the major portion of financing water projects. New sources of project financing, both public and private, will have to be found. While policy specifically applicable to this project has not yet been established, non-Federal interests can expect that under the present administration's financing and cost-sharing principles the level of their financial participation will need to be significantly greater than in the past. It has been proposed by the administration that cost sharing for flood control be 65 percent Federal and 35 percent non-Federal (See Table A-4-1).

FEDERAL RESPONSIBILITIES

A.4.5. After congressional authorization and funding, the Federal government would design and prepare plans for the authorized project. After execution of the required non-Federal responsibilities, the United States would implement and supervise the work until completion of the project.

TABLE A-4-1

COMPARISON OF COST-SHARING

January 1985 Prices 8 - 3/8 Percent

Item	Traditional Policy	Present Administration Initiative
	($000)	
Total First Cost	$6,900.0	$6,900.0
Federal	6,886.8	4,485.0
Non-Federal	13.2	2,415.0
Average Annual	$ 731.0	$ 731.0
Federal	670.0	475.0
Non-Federal	61.0 1/	256.0 1/

1/ Includes $19,000 for project operation and maintenance, $10,000 for mitigation operation and maintenance, $31,000 for on-farm drainage, and $1,000 for interest and amortization on lands and damages.

A.4.6. The presently estimated Federal share of the total first cost of the tentatively selected plan is $6,886,800. There would be no Federal share for annual operations and maintenance of the project.

NON-FEDERAL RESPONSIBILITIES

A.4.7. Under the traditional cost-sharing policy, there is no non-Federal share of the construction costs. However, provisions for greater cost sharing are under review by the present administration. Prior to construction of this project, non-Federal interests would be required to:

o Provide without cost to the United States, all lands, easements, rights-of-way, disposal areas, and the relocation of, bridges (except railroad bridges) and roads, pipelines, and utilities that may be required for construction of the project, presently estimated at $13,000;

o Hold and save the United States free from damages due to the construction, operation and maintenance of the project, except where such damages are due to the fault or negligence of the United States or its contractors;

o Operate and maintain the works including mitigation after completion in accordance with regulations prescribed by the Secretary of the Army; and

o Provide in the form of cash or contribution equal in value as may be agreed upon the costs of mitigation in the same proportions as the total costs for flood control, presently estimated at $200.

A.4.8. In addition, the non-Federal entity must agree to comply with the following:

o Comply with Section 221, Public Law 91-611, approved 31 December 1970, as amended.

o Section 601 of Title VI of the Civil Rights Act of 1964 (PL 88-352) that no person shall be excluded from participation in, denied the benefits of, or subjected to discrimination in connection with the project on the grounds of race, creed, or national origin; and

o The applicable provisions of the Uniform Relocation Assistance and Real Policies Act of 1970, Public Law 91-646.

APPENDIX B

NATURAL RESOURCES

ALOHA-RIGOLETTE AREA, LOUISIANA

TABLE OF CONTENTS

ALOHA - RIGOLETTE AREA STUDY

Appendix B

NATURAL RESOURCES

The Natural Resources Appendix contains the environmental related analysis of the study. Section 1 consists of an evaluation of threatened and endangered species. Section 2 consists of rationale for predicting that no induced clearing of forestlands will occur with the project. Section 3 consists of a Section 404(b)(1) Evaluation. Section 4 consists of the Farmland Conversion Impact Ratings for both parishes impacted as required by the Farmland Protection Policy Act of 1981. Section 5 consists of the U.S. Fish and Wildlife Service Draft Fish and Wildlife Coordination Act Report.

SECTION 1. EVALUATION OF THREATENED AND ENDANGERED SPECIES

The U.S. Fish and Wildlife Service determined that no present or proposed endangered or threatened species, or their critical habitat, occurs within the study area. A copy of the letter is attached. Therefore, no further consideration of endangered species is required.

United States Department of the Interior
FISH AND WILDLIFE SERVICE
JACKSON MALL OFFICE CENTER
300 WOODROW WILSON AVENUE, SUITE 3185
JACKSON, MISSISSIPPI 39213
September 8, 1983

IN REPLY REFER TO:
Log No. 4-3-83-491

Mr. Cletis R. Wagahoff
Chief, Planning Division
U.S. Army, Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Mr. Wagahoff:

This responds to your letter of August 18, 1983, received in our office August 24, 1983, concerning the Bayou Du Grappe and Bayou Rigolette drainage basins flood protection activities, Grant and Rapides Parishes, Louisiana. The following comments are provided in accordance with the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.):

Our records indicate no endangered, threatened or proposed species, or their Critical Habitat occurring in the project area. Therefore, no further endangered species consultation will be required for this project, as currently described.

If you require further information regarding this project, please contact our office, telephone 601/960-4900.

We appreciate your participation in the effort to promote the continued existence of endangered species.

Sincerely yours,

Dennis B. Jordan
Dennis B. Jordan
Field Supervisor
Endangered Species Field Office

cc: D, FWS, Washington, D.C. (AFA/OES)
RD, FWS, Atlanta, GA (AFA/SE)
Department of Wildlife & Fisheries, New Orleans, LA
ES, FWS, Lafayette, LA

SECTION 2. RATIONALE FOR PREDICTING INDUCED CLEARING OF BOTTOMLAND HARDWOODS FOR AGRICULTURAL PURSUITS

The methodology used to predict induced clearing assumed that the area afforded protection by the project (the area between the with and without project 3-year floodplains) would develop as the area between the existing 3-year and 10-year floodplains did historically. Since all the project area soil types are conducive to agricultural pursuits, soil type was not considered a limiting factor.

METHODOLOGY

Step 1. The existing land use patterns for lands between the 3-year and 10-year floodplains were calculated for each project reach. (Stage area curves are attached as Figures 2 and 3).

Step 2. The number of acres protected (removed from the existing 3-year floodplains) by each alternative was then calculated.

Step 3. The existing woodlands percentage (from Step 1) was then applied to the total protected acres (from Step 2) to result in the number of acres that are expected to remain wooded with the project.

Step 4. The number of acres expected to remain wooded (products of Step 3) were then subtracted from the number of wooded acres protected by each plan (Step 2) to result in amount of induced clearing expected with each plan.

Example: DuGrappe Reach with Plan 6B:

Step 1

	Cleared	Wooded
10-year	2,839	1,076
3-year	2,367	845
Area between 3 and 10-year floodplains:	472	231
	67%	33%

Step 2

	Cleared	Wooded
Existing 3-year	2,367	845
With project 3-year	0	0
Area protected:	2,367	845

Step 3

Total Protected Area = 2,367 + 845 = 3,212

Total Protected Area x Wooded % = Areas expected to remain wooded

3,212 x 33% = 1,006

Step 4

Wooded Acres Protected - Wooded Acres Expected to Remain = Amount of induced clearing

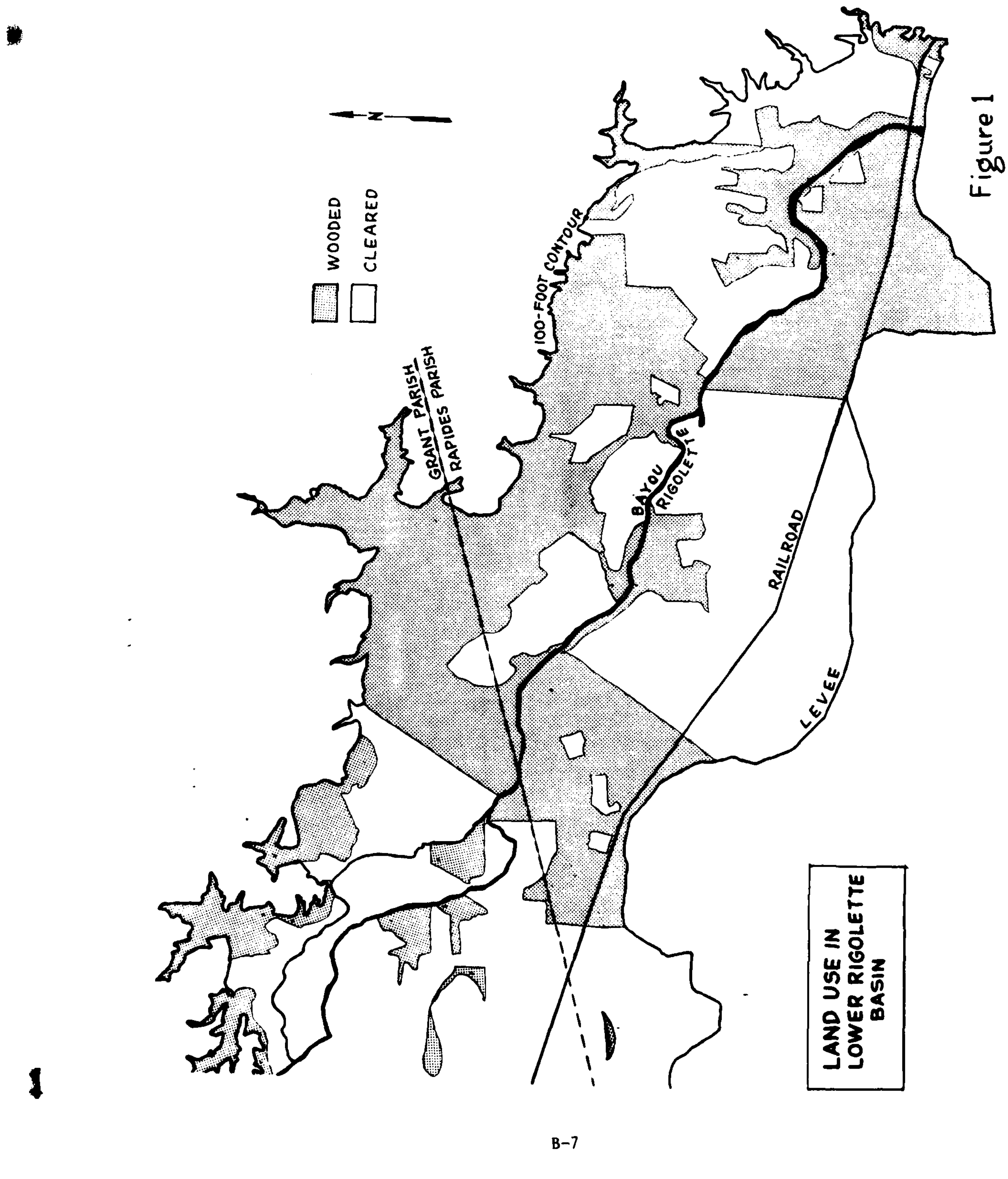
845 - 1,006 = <0

Therefore, no induced clearing is predicted.

The current land-use maps were also examined for indications of historical land-clearing patterns. The clearing that has occurred within the lower basin (that part of the basin with substantial remaining woodlands) has not occurred along elevation contours, but appears to have occurred along property lines instead (Figure 1). For this reason, we feel that the

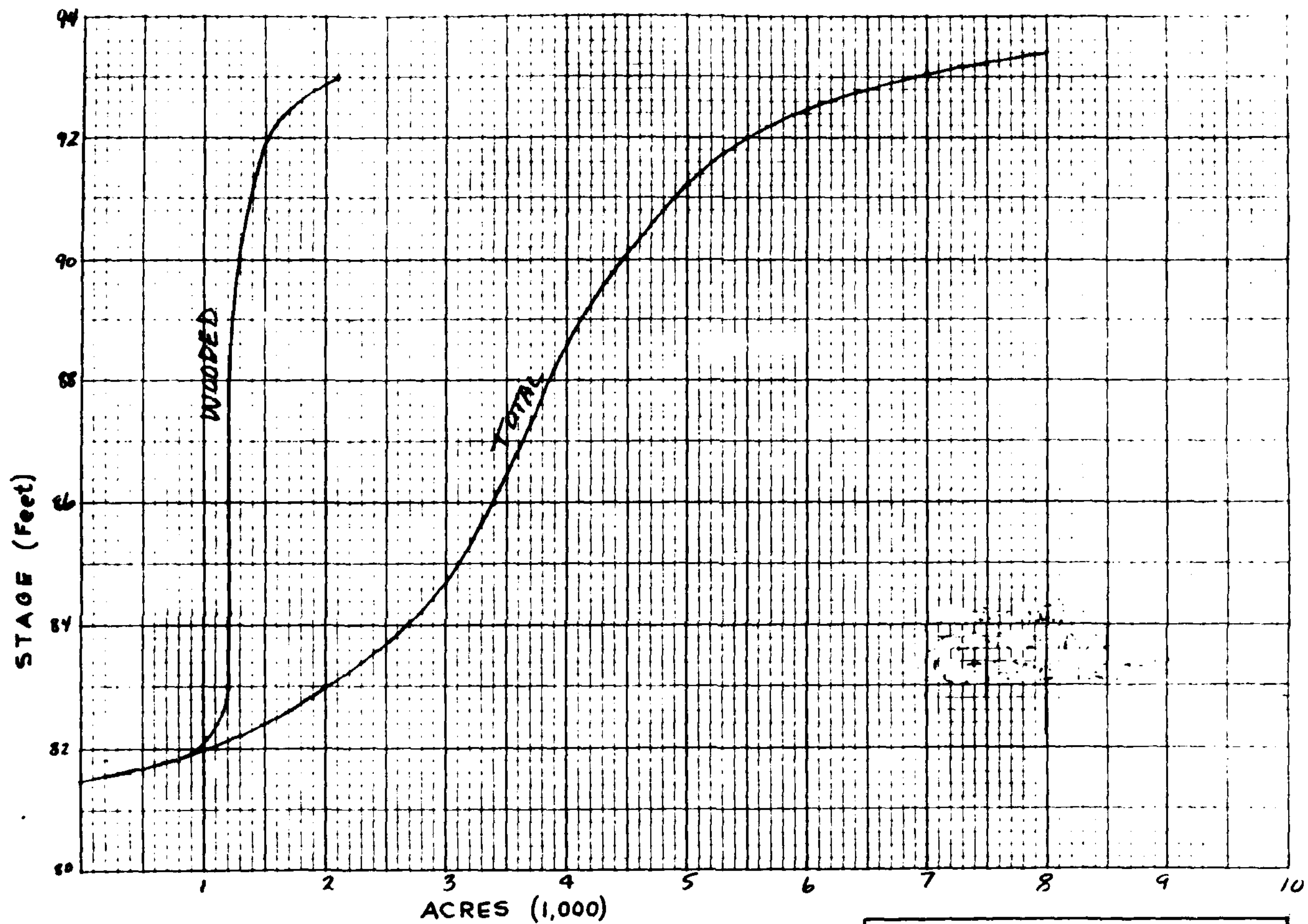
clearing that has occurred was more a function of property ownership and economics rather than the degree of flood protection provided.

Additionally, in the fall of 1982, Gulf South Research Institute conducted field interviews with area farmers to determine land use, crop yields, and flood problems. Approximately 40 farmers were interviewed whose farmland represented 40,500 acres, which is 67% of the total land in the study area. One question asked pertained to what changes in land use the farmer would make if the frequency of flooding were reduced by half. None of the farmers interviewed indicated that any remaining woodlands not cleared because of flooding problems would be cleared if flooding were substantially alleviated.



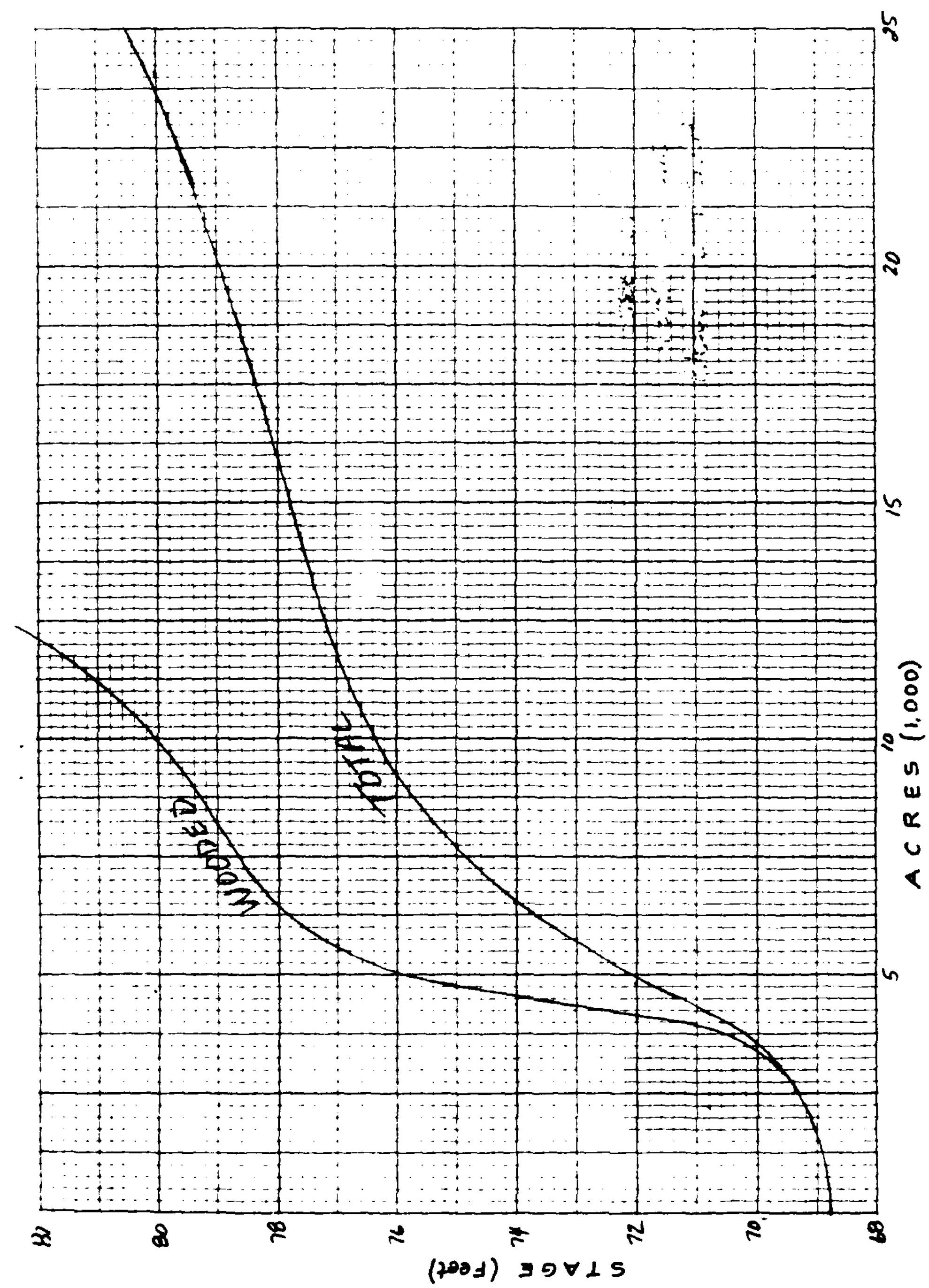
LAND USE IN LOWER RIGOLETTE BASIN

Figure 1



STAGE - AREA
ALOHA-RIGOLETTE
DUGRAPPE REACH

Figure 2



STAGE - AREA
ALOHA - RIGOLETTE
RIGOLETTE REACH

Figure 3

SECTION 3. SECTION 404(b)(1) EVALUATION

PROJECT: Aloha-Rigolette WORK ITEM: Cofferdam

SECTION 404(b)(1) EVALUATION

The following short form 404(b)(1) evaluation follows the format designed by the Office of the Chief of Engineers, (OCE). As a measure to avoid unnecessary paperwork and to streamline regulation procedures while fulfilling the spirit and intent of environmental statutes, New Orleans District is using this format for all proposed project elements requiring 404 evaluation, but involving no significant impact.

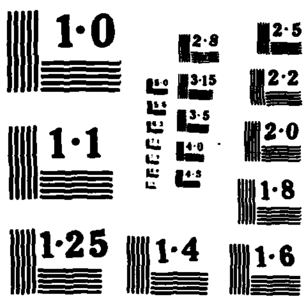
1. Review of Compliance (§230.10 (a)-(d)).	Preliminary[1]		Final[2]	
A review of this project indicates that:				
a. The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem to fulfill its basic purpose (if no, see section 2 and information gathered for environmental assessment alternative);	YES	NO*	YES	NO
b. The activity does not appear to: (1) violate applicable state water quality standards or effluent standards prohibited under Section 307 of the Clean Water Act; (2) jeopardize the existence of Federally listed endangered or threatened species or their habitat; and (3) violate requirements of any Federally designated marine sanctuary (if no, see section 2b and check responses from resource and water quality certifying agencies);	YES	NO*	YES	NO
c. The activity will not cause or contribute to significant degradation of waters of the United States including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, esthetic, and economic values (if no, see section 2);	YES	NO*	YES	NO
d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem (if no, see section 5).	YES	NO*	YES	NO

2. Technical Evaluation Factors (Subparts C-F).	N/A	Not Significant	Significant*
a. Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C).			
(1) Substrate impacts.		X	
(2) Suspended particulates/turbidity impacts.		X	
(3) Water column impacts.		X	
(4) Alteration of current patterns and water circulation.		X	
(5) Alteration of normal water fluctuations/hydroperiod.		X	
(6) Alteration of salinity gradients.	X		

1,2,* See page 4.

AD A160 791 ALOHA - RIGOLETTE AREA LOUISIANA AGRICULTURAL FLOOD CONTROL VOLUME 2 TECHNICAL APPENDIXES A B C D E(U) ARMY ENGINEER DISTRICT NEW ORLEANS LA JUN 85 2/5

UNCLASSIFIED F/G 13/2 NL


1·0
2·8
2·5
3·15
2·2
3·5
1·1
2·0
4·0
4·5
1·8
1·25
1·4
1·6

1

	N A	Not Significant	Significant
b. Biological Characteristics of the Aquatic Ecosystem (Subpart D).			
(1) Effect on threatened/endangered species and their habitat.	X		
(2) Effect on the aquatic food web.		X	
(3) Effect on other wildlife (mammals, birds, reptiles and amphibians).		X	
c. Special Aquatic Sites (Subpart E).			
(1) Sanctuaries and refuges.	X		
(2) Wetlands.		X	
(3) Mud flats.	X		
(4) Vegetated shallows.	X		
(5) Coral reefs.	X		
(6) Riffle and pool complexes.	X		
d. Human Use Characteristics (Subpart F).			
(1) Effects on municipal and private water supplies.	X		
(2) Recreational and commercial fisheries impacts.		X	
(3) Effects on water-related recreation.		X	
(4) Esthetic impacts.		X	
(5) Effects on parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves.	X		

<u>Remarks</u>: Where a check is placed under the significant category, preparer has attached explanation.

3. <u>Evaluation of Dredged or Fill Material (Subpart G)</u>.[3]

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material.

(1) Physical characteristics X
(2) Hydrography in relation to known or anticipated sources of contaminants . . . X
(3) Results from previous testing of the material or similar material in the vicinity of the project . . . . ___
(4) Known, significant, sources of persistent pesticides from land runoff or percolation . . . . ___
(5) Spill records for petroleum products or designated (Section 311 of CWA) hazardous substances . . . . ___
(6) Other public records of significant introduction of contaminants from industries, municipalities, or other sources . . . . ___
(7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities . . . . ___
(8) Other sources (specify) . . . . ___

Appropriate references:

U.S. EPA STORET Computerized data base.

b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredge or fill material is not a carrier of contaminants, or that levels of contaminants are substantively similar at extraction and disposal sites. The material meets the testing exclusion criteria.

<u>YES</u>   NO*

[3]See page 4.

4. <u>Disposal Site Delineation (§230.11(f))</u>.

a. The following factors as appropriate, have been considered in evaluating the disposal site.

(1) Depth of water at disposal site X
(2) Current velocity, direction, and variability at disposal site . . . . ___
(3) Degree of turbulence . . . . ___
(4) Water column stratification . . . . ___
(5) Discharge vessel speed and direction . . . . ___
(6) Rate of discharge . . . . ___
(7) Dredged material characteristics (constituents, amount, and type of material, settling velocities) X
(8) Number of discharges per unit of time . . . . ___
(9) Other factors affecting rates and patterns of mixing (specify) . . . . ___

Appropriate references:

See Item 3.

b. An evaluation of the appropriate factors in 4a above indicates that the disposal site and/or size of mixing zone are acceptable.

<u>YES</u> NO*

5. <u>Actions to Minimize Adverse Effects (Subpart H)</u>.

All appropriate and practicable steps have been taken, through application of the recommendations of §230.70-230.77 to ensure minimal adverse effects of the proposed discharge.

<u>YES</u> NO*

Actions taken:

None.

6. **<u>Factual Determination (§230.11)</u>**.

A review of appropriate information as identified in items 2-5 above indicates that there is minimal potential for short- or long-term environmental effects of the proposed discharge as related to:

a. Physical substrate at the disposal site (review sections 2a, 3, 4, and 5 above). <u>YES</u> NO*

b. Water circulation, fluctuation and salinity (review sections 2a, 3, 4, and 5). <u>YES</u> NO*

c. Suspended particulates/turbidity (review sections 2a, 3, 4, and 5). <u>YES</u> NO*

d. Contaminant availability (review sections 2a, 3, and 4). <u>YES</u> NO*

e. Aquatic ecosystem structure and function (review sections 2b, and c, 3, and 5). <u>YES</u> NO*

*See page 4.

f. Disposal site (review sections 2, 4, and 5). YES NO*

g. Cumulative impact on the aquatic ecosystem. YES NO*

h. Secondary impacts on the aquatic ecosystem. YES NO*

*A negative, significant, or unknown response indicates that the project may not be in compliance with the Section 404(b)(1) Guidelines.

[1]Negative responses to three or more of the compliance criteria at this stage indicates that the proposed projects may not be evaluated using this "short form procedure". Care should be used in assessing pertinent portions of the technical information of items 2a-d, before completing the final review of compliance.

[2]Negative response to one of the compliance criteria at this stage indicates that the proposed project does not comply with the guidelines. If the economics of navigation and anchorage of Section 404(b)(2) are to be evaluated in the decision-making process, the "short form" evaluation process is inappropriate.

[3]If the dredged or fill material cannot be excluded from individual testing, the "short form" evaluation process is inappropriate.

7. Evaluation Responsibility.

a. This evaluation was prepared by: Ken Froehlich

Position: Environmental Resources Specialist

Date: May 13, 1985

b. This evaluation was reviewed by: Sue Hawes

Position: C/Environmental Quality Section

Date: May 14, 1985

8. Findings.

a. The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines X

b. The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines with the inclusion of the following conditions . . . . . ___

c. The proposed disposal site for discharge of dredged or fill material does not comply with the Section 404(b)(1) guidelines for the following reason(s):

(1) There is a less damaging practicable alternative . . . . ___
(2) The proposed discharge will result in significant degradation of the aquatic ecosystem . . . . ___
(3) The proposed discharge does not include all practicable and appropriate measures to minimize potential harm to the aquatic ecosystem . . . . ___

DATE: 20 MAY 85

SIGNATURE Eugene S. Witherspoon

Eugene S. Witherspoon
Colonel, Corps of Engineers
District Engineer

SECTION 4. FARMLAND CONVERSION IMPACT RATING AS REQUIRED BY THE FARMLAND PROTECTION POLICY ACT OF THE FARMLAND PROTECTION ACT OF 1981

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I (To be completed by Federal Agency)	Date Of Land Evaluation Request: May 6, 1985
Name Of Project: Aloha-Rigolette Area, Louisiana	Federal Agency Involved: U. S. Army Corps of Engineers
Proposed Land Use: Inflow and outflow channel for proposed floodgates	County And State: Rapides Parish, LA
PART II (To be completed by SCS)	Date Request Received By SCS: May 13, 1985

Does the site contain prime, unique, statewide or local important farmland? (If no, the FPPA does not apply — do not complete additional parts of this form).	Yes ☒ No ☐	Acres Irrigated: N/A	Average Farm Size: 197
Major Crop(s): soybeans, cotton, corn, grain sorghum	Farmable Land In Govt. Jurisdiction: Acres: 638,116 % 75	Amount Of Farmland As Defined in FPPA: Acres: 511,293 % 60	
Name Of Land Evaluation System Used: Rapides Parish	Name Of Local Site Assessment System: None	Date Land Evaluation Returned By SCS: 5/20/85	

	Maximum Points	Site A (5C)	Site B	Site C	Site D
PART III (To be completed by Federal Agency)					
A. Total Acres To Be Converted Directly		20			
B. Total Acres To Be Converted Indirectly		N/A			
C. Total Acres In Site		20			
PART IV (To be completed by SCS) Land Evaluation Information					
A. Total Acres Prime And Unique Farmland		16			
B. Total Acres Statewide And Local Important Farmland		0			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted		.001			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value		20.8			
PART V (To be completed by SCS) Land Evaluation Criterion Relative Value Of Farmland To Be Converted (Scale of 0 to 100 Points)		85			
PART VI (To be completed by Federal Agency) Site Assessment Criteria (These criteria are explained in 7 CFR 658.5(b)					
1. Area In Nonurban Use		3			
2. Perimeter In Nonurban Use		3			
3. Percent Of Site Being Farmed		0			
4. Protection Provided By State And Local Government		0			
5. Distance From Urban Builtup Area		15			
6. Distance To Urban Support Services		15			
7. Size Of Present Farm Unit Compared To Average		0			
8. Creation Of Nonfarmable Farmland		8			
9. Availability Of Farm Support Services		5			
10. On-Farm Investments		0			
11. Effects Of Conversion On Farm Support Services		0			
12. Compatibility With Existing Agricultural Use		0			
TOTAL SITE ASSESSMENT POINTS	160	49			
PART VII (To be completed by Federal Agency)					
Relative Value Of Farmland (From Part V)	100	85			
Total Site Assessment (From Part VI above or a local site assessment)	160	49			
TOTAL POINTS (Total of above 2 lines)	260	134			

Site Selected: 5C	Date Of Selection: May 1985	Was A Local Site Assessment Used? Yes ☐ No X

Reason For Selection

Plan 5C was designated the NED Plan and, therefore, tentatively recommended for implementation.

(See Instructions on reverse side)

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request: May 27, 1985
Name Of Project: Aloha-Rigolette Area, Louisiana	Federal Agency Involved: U.S. Army Corps of Engineers
Proposed Land Use: Channel improvements and floodgate construction	County And State: Grant Parish, LA
PART II *(To be completed by SCS)*	Date Request Received By SCS: May 28, 1985

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply — do not complete additional parts of this form).* Yes ☒ No ☐	Acres Irrigated: 0	Average Farm Size: 188 ac.
Major Crop(s): Timber, Soybeans, Beef, Cotton, Small Grain, and Hay	Farmable Land In Govt. Jurisdiction: Acres: 306,299 % 74	Amount Of Farmland As Defined in FPPA: Acres: 306,299 % 74
Name Of Land Evaluation System Used: Grant Parish	Name Of Local Site Assessment System: None	Date Land Evaluation Returned By SCS: June 17, 1985

	Maximum Points	Alternative Site Rating: Site A (60)	Site B	Site C	Site D
PART III *(To be completed by Federal Agency)*					
A. Total Acres To Be Converted Directly		462			
B. Total Acres To Be Converted Indirectly		N/A			
C. Total Acres In Site		462			
PART IV *(To be completed by SCS)* **Land Evaluation Information**					
A. Total Acres Prime And Unique Farmland		392			
B. Total Acres Statewide And Local Important Farmland		53			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted		.001			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value		4.4			
PART V *(To be completed by SCS)* **Land Evaluation Criterion** Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*		87			
PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use		15			
2. Perimeter In Nonurban Use		10			
3. Percent Of Site Being Farmed		4			
4. Protection Provided By State And Local Government		0			
5. Distance From Urban Builtup Area		NA			
6. Distance To Urban Support Services		NA			
7. Size Of Present Farm Unit Compared To Average		6			
8. Creation Of Nonfarmable Farmland		0			
9. Availability Of Farm Support Services		5			
10. On-Farm Investments		20			
11. Effects Of Conversion On Farm Support Services		0			
12. Compatibility With Existing Agricultural Use		0			
TOTAL SITE ASSESSMENT POINTS	160				
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	87			
Total Site Assessment *(From Part VI above or a local site assessment)*	160	60			
TOTAL POINTS *(Total of above 2 lines)*	260	147			

Site Selected: 5C (Rapides Parish)	Date Of Selection: May 1985	Was A Local Site Assessment Used? Yes ☐ No ☒

Reason For Selection

(See Instructions on reverse side)

Form AD-1006 (10-83)

SECTION 5. U.S. FISH AND WILDLIFE SERVICE DRAFT FISH AND WILDLIFE COORDINATION ACT REPORT

ALOHA-RIGOLETTE AREA

LOUISIANA, STUDY

REVISED DRAFT

FISH AND WILDLIFE COORDINATION ACT REPORT

SUBMITTED TO

NEW ORLEANS DISTRICT

U.S. ARMY CORPS OF ENGINEERS

NEW ORLEANS, LOUISIANA

PREPARED BY

ROBERT W. STRADER, FISH AND WILDLIFE BIOLOGIST

AND

THERESA E. SLATTERY, WILDLIFE BIOLOGIST

UNDER THE SUPERVISION OF

DAVID W. FRUGE, FIELD SUPERVISOR

DIVISION OF ECOLOGICAL SERVICES

LAFAYETTE, LOUISIANA

RELEASED FROM

U.S. FISH AND WILDLIFE SERVICE

LAFAYETTE FIELD OFFICE

LAFAYETTE, LOUISIANA

JUNE 1985

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LIST OF FIGURES

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EXECUTIVE SUMMARY

Attached is the revised draft Fish and Wildlife Coordination Act Report (FWCAR) of the Fish and Wildlife Service (FWS) for the U.S. Army Corps of Engineers' (Corps) study, Aloha-Rigolette Area, Louisiana. The proposed project would improve flood protection originally provided by a Corps project completed in 1956. That project included levee work along the Red River, installation of a floodgate near the mouth of Bayou Rigolette, clearing and snagging of area waterways, and designation of a 12,000-acre sump area for floodwater storage. The Corps did not purchase flowage or non-development easements in the sump area.

Between 1956 and 1978, flood reduction and soybean demand encouraged the conversion of nearly 16,000 acres (including a significant portion of the sump area) of bottomland hardwoods to row-crop agriculture. Land clearing has increased the economic value of the area and accelerated surface water runoff. Local interests have failed to adequately maintain prior Federal flood control measures. These factors have reduced the adequacy of previous flood control measures, increased flooding losses and resulted in requests for additional flood protection.

Alternatives considered in this report for possible implementation include the "no-action" alternative, Plan 5C, Plan 6A, and Plan 19C. All action alternatives involve the construction of about 1,700 feet of new channel and six floodgates. Plan 6A also involves intensive clearing and snagging of about 25 miles of streams. Plan 19C also includes the purchase of non-development easements on all forested land below the 5-year flood plain.

The riparian and bottomland hardwood habitat types in the study area are the most valuable for wildlife and support migratory waterfowl and other migratory birds, numerous commercially important furbearers, and game mammals. Agricultural lands that experience winter flooding are also valuable to wintering waterfowl. Area streams provide moderate quality habitat for numerous sport and commercial warmwater fishes.

Project impacts were quantified using habitat acreages, recreational and commercial (man-day/monetary) fish and wildlife values, FWS's Habitat Evaluation Procedures (HEP), and an acre-day analysis of flooding during the waterfowl wintering period. The FWS disagrees with the Corps' land-use projection that the reduction in flood elevations will not induce the clearing and conversion of bottomland hardwood forest to agriculture. The FWS method assumes the clearing and conversion of 75 percent of the forested land that would be removed from the 3-year flood plain by project implementation.

The greatest impacts associated with implementation of Plan 5C (the tentatively selected plan) include the average annual loss of 1,070 acres of bottomland hardwood habitat, 1,724 potential man-days of fish and wildlife-related recreation, $12,951 of sport and commercial fish and wildlife resources, and 1,439 average annual habitat units

(AAHU's). Plan 6A is expected to cause the greatest adverse impacts on fish and wildlife resources. These impacts include the average annual loss of 491 acres of riparian habitat and 1,685 acres of bottomland hardwood habitats, 11,875 potential man-days (average annual) of fish and wildlife-related recreation, $57,604 of sport and commercial fish and wildlife resources, and 3,851 AAHU's. Plan 19C is the only "action" alternative that will not significantly impact fish and wildlife resources.

Using the HEP and a hypothetical mitigation plan, the FWS estimates that mitigation of damages associated with Plan 5C would require the purchase and management of about 1,423 acres of cleared agricultural lands and riparian habitats. Mitigation of damages associated with Plan 6A would require the purchase and management of at least 2,752 acres of riparian and cleared habitat types. Mitigation for project damages to fishery resources would also be required for Plan 6A. Potential mitigation measures for fishery losses include the purchase of necessary flowage easements to facilitate the periodic drawdown of Iatt Lake for aquatic weed control and fishery management, and the provision of improved instream flows for Bayou Rigolette below Iatt Lake. Mitigation of HEP-determined impacts associated with Plan 19C could be accomplished through minor project modification.

Recent research indicates that temporarily flooded winter wetlands are essential to the desirable distribution and reproductive success of mallards and wood ducks. The proposed project would have an adverse effect on winter flooding and is expected to negatively impact waterfowl populations. Using an acre-day analysis (Table 5), the FWS estimates that 337 acres would have to be flooded for a minimum of 120 days during the winter months to mitigate for the wintering waterfowl losses incurred by Plan 5C or 19C. Plan 6A would require 642 acres of flooding for at least 120 days. These acres could be included in the total acres required for management to compensate for project damages to wildlife resources, as determined via the HEP analysis.

The FWS recommends that the following measures be taken to assure that fish and wildlife receive equal consideration during further project planning and implementation.

1. Plan 19C should be the alternative selected for implementation, and should be modified to provide for 40,374 acre-days of flooding during the waterfowl wintering period (November 1 to March 1) to compensate for project-induced losses of waterfowl wintering habitat.

2. If Plan 5C is selected, mitigation should include the purchase and management of 1,425 acres of cleared and riparian habitats. At least 337 of those acres should be flooded for 120 days during November 1 to March 1 to provide at least 40,374 acre-days of flooding for wintering waterfowl.

3. If Plan 6A is selected, mitigation should include the purchase and management of an estimated 2,752 acres of

cleared and riparian habitats, as well as the purchase of flowage easements to facilitate water-level management in Iatt Lake and to improve aquatic habitat quality in Bayou Rigolette. At least 642 of those acres should be flooded for 120 days during November 1 to March 1 in order to provide for a minimum of 77,076 acre-days of flooding for wintering waterfowl.

4. Mitigation measures should be implemented simultaneously with other project features.

5. Administration and management of lands acquired in fee simple should be in accordance with the General Plan process contained in Section 3b. of the Fish and Wildlife Coordination Act.

6. The initial development, replacement, and annual operation and maintenance costs for the mitigation lands shall be provided by the Corps as an integral project expense.

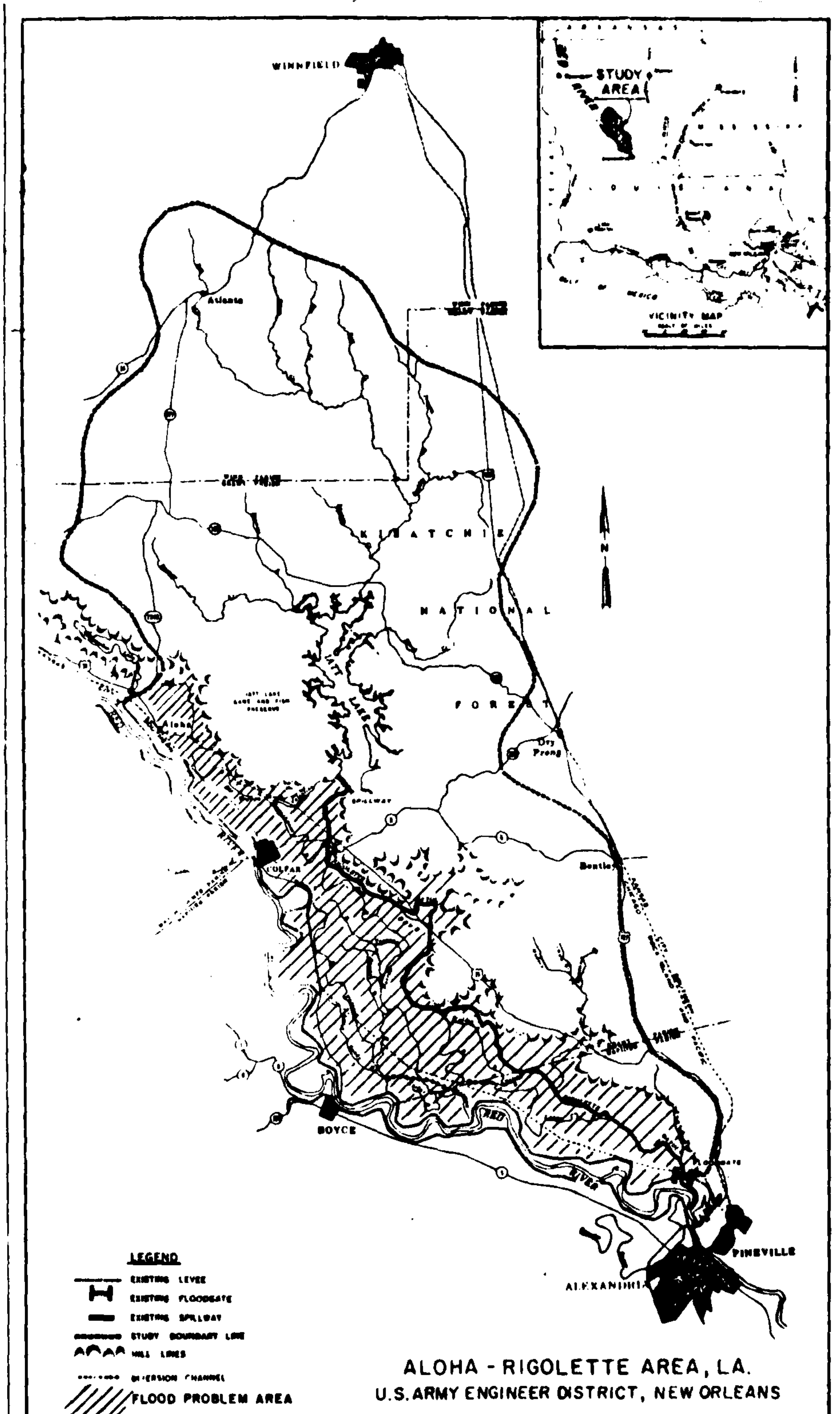
PROJECT DESCRIPTION

The Aloha-Rigolette Area, Louisiana, study was authorized by a resolution adopted by the Senate Committee on Public Works and Environment on May 22, 1974. The resolution required the U.S. Army Corps of Engineers (Corps) to determine the advisability of providing flood protection to the study area. The Aloha-Rigolette Area is located in central Louisiana northwest of Alexandria and includes portions of Grant and Rapides Parishes (Figure 1).

The proposed project would improve flood protection originally provided by the Aloha-Rigolette Area, Grant and Rapides Parishes, Louisiana, project. The latter project was authorized by the Flood Control Act of August 18, 1941, and completed in 1956; it provided flood protection to the left bank of the Red River flood plain approximately from the town of Aloha to the city of Pineville via levees, diversion channels, channel works, and a floodgate. The levees protect the flood plain from Red River floods, but prevent the drainage of water from the Bayou Rigolette Basin into the Red River whenever stages on the Red River require closure of the Bayou Rigolette floodgate.

In conjunction with operation of the project completed in 1956, the Corps established a 48,000-acre sump area within the project area for storage of surface runoff during high stages on the Red River and, based on a 5-year flood frequency with the floodgates open, there were 12,000 acres available for storage of surface water runoff. However, the Corps did not purchase flowage or non-development easements to compensate landowners for flooding losses in the sump or to prevent development in either of the two areas.

Maintenance of cleared stream banks was to have been a local responsibility. The Rapides Parish portion of the project has been



WINNFIELD
STUDY AREA
VICINITY MAP
KISATCHIE NATIONAL FOREST
Aloha
Dry Prong
COLFAX
Bentley
BOYCE
RED RIVER
PINEVILLE
ALEXANDRIA
LEGEND
EXISTING LEVEE
EXISTING FLOODGATE
EXISTING SPILLWAY
STUDY BOUNDARY LINE
HILL LINES
DIVERSION CHANNEL
FLOOD PROBLEM AREA
SCALE IN MILES
ALOHA - RIGOLETTE AREA, LA.
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

FIGURE - 1

maintained and shrubby growth is practically the only woody vegetation on the stream banks. However, the Grant Parish portion of the project has not been maintained and mature trees grow to the water's edge, with some overhanging the bayous. Despite the possible reduction in channel efficiency due to inadequate maintenance, local residents claim that much of the flooding that occurs at times when the floodgate can be left open is due to the floodgate's inadequate capacity.

Flood protection and high soybean demand facilitated the conversion of nearly 16,000 acres of bottomland hardwoods to row crop agriculture in the study area between 1956 to 1978. (U.S. Army Corps of Engineers 1981). About 2,300 acres of the 12,000-acre storage area was cleared for crop production during that period. Land clearing has increased the economic value of the study area, as well as the amount and rate of surface water runoff. The increased volume and accelerated rate of rainwater runoff has undoubtedly reduced the adequacy of the existing flood gate and has probably increased the area affected by flooding. Flooding of cropland not previously flooded and newly cleared lands in the 12,000-acre sump area is believed to have further increased monetary losses in the project area. These problems, coupled with local interests' failure to maintain prior Federal flood control measures, have, in our opinion, led to pleas for additional improvements.

As late as October 1983, 10 project alternatives were being evaluated along with the "No Action" or future without-project (FWOP), alternative. Action alternatives addressed in this report include Plans 5C, 6A, and 19C.

Plan 5C, which has been designated the Tentatively Selected Plan (TSP), provides for increasing the outlet capacity of the floodgate on Bayou Rigolette via the addition of six floodgates of the same size as the existing floodgate (i.e., two 10-foot-by-10-foot box culverts). The new floodgates would be located approximately 600 feet east of the existing floodgate. The inflow channel would branch east of the existing channel just south of the Kansas City Southern Railway and extend 680 feet to the floodgate. The box culverts for all options are 210 feet in length and have a sill elevation of 59 feet National Geodetic Vertical Datum (NGVD) on the upstream end and 57 feet NGVD at the downstream end. The outflow channel extends 1,010 feet and connects with the outlet channel for the existing structure. Plan 6A involves the diversion of Bayou Rigolette into Bayou Darrow and thence to the Red River. To accomplish this, the existing closure between Bayou Darrow and Bayou Rigolette would be removed and an earthen closure would be placed across Bayou Rigolette just below its juncture with Bayou Darrow. To prevent the flow in Bayou Darrow from seeking a path down the existing diversion channels, an earthen closure would be constructed across the channel. Six floodgates of the same size as the existing floodgates would be added to Bayou Rigolette. A total of 23.2 miles of Bayou Darrow, Bayou Rigolette, Sam's Bayou, and Saline Bayou would be cleared and snagged. The clearing and snagging includes removal of all obstructions from the channel banks using a dragline operated from 40-foot rights-of-way (berms) on one or both

channel bank(s). Material removed will be placed on the same channel bank that the dragline operates. Maintenance of these channels would occur every 12 years.

Plan 19C is an expansion of Plan 5, and includes acquisition of a non-development easement over all wooded lands within the with-project 5-year flood plain. This easement would prohibit clearing of these woodlands and would regulate timber harvest methods.

The Red River Waterway (RRWW), Louisiana, Texas, Arkansas, and Oklahoma, project will provide a navigation channel on the Red River. Lock and Dam No. 2, an integral part of that project, is presently being constructed to hold pool elevations at 64 feet NGVD (U.S. Army Corps of Engineers, New Orleans District 1983a). The 64-foot pool elevation will affect the study area by holding stages as much as 5 feet above current low water levels in the southernmost part of the Bayou Rigolette flood plain.

AREA SETTING

General

The Bayou Rigolette drainage basin encompasses 418 square miles on the left descending bank of the Red River between river miles 125 and 170. The basin lies within the Gulf Coastal Plain and is composed of the Bayou Rigolette flood plain, the Iatt Creek flood plain, and the Kisatchie Hills uplands. The broad Bayou Rigolette flood plain is traversed by sluggish warmwater streams, while the Iatt Creek flood plain includes the 7,100-acre Iatt Lake and consists of narrow flood zones associated with smaller, higher gradient warmwater streams traversing the Kisatchie Hills uplands.

Virtually all project impacts would occur within that portion of the Bayou Rigolette basin inundated by the 100-year flood event, with the floodgates closed. Therefore, the area considered in this report includes only the 42,057-acre Bayou Rigolette 100-year flood plain. Bayou Rigolette lies in the Red River alluvial plain and occupies an ancient channel of the Red River. Historically, the entire Bayou Rigolette flood plain served as a backwater area during high stages on the Red River. Until completion of the Corps' original Aloha-Rigolette Area project in 1956, Bayou Darrow and possibly Bayou Marteau drained into the Red River from the present Bayou Rigolette basin. Tributary streams that provide interior drainage are Iatt Creek, Bayou DuGrappe, Sugarhouse Bayou, Sam's Bayou, Walden Bayou, Saline Bayou, and Caney Bayou.

Climate in the study area is subtropical, characterized by high humidity, long hot summers, and mild winters. Average annual rainfall is about 56 inches.

Elevations range from about 65 feet NGVD near the Bayou Rigolette floodgate to 100 feet NGVD in the northernmost reaches of the area. Topography is generally flat.

Most land in the study area that is suitable for intensive agriculture has been cleared and devoted to row crops or pasture. Elevation and flood frequency are two principal factors discouraging the clearing of the remaining woodland. Some of the remaining forested acreage is devoted to forestry and wildlife uses.

Description of Habitats

The habitats within the study area can be broadly classified as upland developed, upland forested, palustrine forested, riverine open water, palustrine open water, and lacustrine open water. Wetland habitat types referenced in this report are according to Cowardin et al. (1979). A list of habitats and existing acreages used for this study is provided in Table 1.

Upland Developed

Virtually all of the upland developed (cleared) habitat within the study area is devoted to row-crops or pasture. Under current farming practices, production of soybeans, milo, corn, cotton, wheat, or various pasture grasses is emphasized. Control of competing plants such as ragweed, Sesbania sp., cocklebur, foxtail, and morning glory greatly reduces habitat value to wildlife. However, extensive agricultural lands flood annually and provide feeding habitat for migratory waterfowl.

Upland Forested

This habitat is generally comprised of the infrequently flooded bottomland hardwood forests in the study area. A few pine or upland hardwoods such as American beech, red oak, or hickory, naturally occur along the periphery of the study area where the Kisatchie hills protrude into the flood plain. Common species in the study area include swamp chestnut oak, water oak, sweet pecan, common persimmon, sugarberry, rattan vine, blackberry, and poison ivy.

Palustrine Forested

The more frequently flooded forested habitats in the study area, including the wet bottomland hardwood and cypress-tupelo associations, are classified as palustrine forested wetlands. These areas are generally limited to the Corps-designated sump area, streambanks, intermittent streams, and shallow semi-permanent water zones. Predominant vegetation in the wet bottomland hardwood areas include Nuttall oak, willow oak, sweetgum, American elm, bitter pecan, deciduous holly, swamp privet, water locust, red maple, black willow, rattan vine, ladies' eardrop, and smartweed. Because of the similarity in habitat values and species composition, upland (infrequently flooded) and palustrine (frequently flooded) bottomland hardwoods are combined and discussed as one habitat type (i.e., bottomland hardwoods) within this report. Bald cypress and tupelo gum also occur in small isolated areas within the study area, often in

Table 1. Acreage of selected habitat types and acreages in the Aloha-Rigolette Area, Louisiana, study area.

Habitat type	Acreages
Cleared	24,051
Riparian	2,913
Bottomland hardwood	15,027
Total	41,991

association with common buttonbush and duckweed. For impact analysis, the small, isolated cypress-tupelo areas were combined with bottomland hardwood habitats.

Because of differences in habitat value of streamside versus other bottomland hardwood and upland developed habitats, riparian habitat was separated from bottomland hardwood habitat for impact evaluation purposes. Riparian habitat is defined here as that area on each bank extending 300 feet from the centerline of the stream channel.

Riverine Open Water

The numerous bayous and canals in the area are classified as riverine open water. Bayou Rigolette, which originates at the outlet of Iatt Lake, is the main channel carrying runoff to the Red River through floodgates at the levee. Bayou Rigolette water levels fluctuate dramatically on a yearly cycle. Water levels are often high during the winter and spring months and nearly level with the bottom of the floodgate during the summer and fall months. In some sections, the streambanks in agricultural areas are devoid of trees. However, in most sections streamside vegetation such as black willow, cottonwood, American sycamore, various oaks, and a wide array of annuals provide shade and in-stream cover for many of the fish species occurring in these streams.

Most of the streams in the lower portion of the study area receive runoff containing pesticides, herbicides, fertilizer, and sediment from adjacent agricultural fields; this runoff reduces water quality, limits the growth of aquatic vegetation, and allows only moderate fishery production. Because these streams also provide water and edge habitat for many wildlife species, they were included as riparian habitat in the description of wildlife resources and analysis of wildlife impacts.

Palustrine Open Water and Lacustrine Open Water

The open water areas of Iatt Lake, greentree reservoirs, small farm ponds, and borrow pits constitute the only lentic waters in or adjacent to the study area. Palustrine open water includes those open water areas less than 20 acres, and lacustrine open water includes those open water areas larger than 20 acres.

Iatt Lake is a shallow, 7,100-acre reservoir located approximately 5 miles northeast of Colfax. Eighty-five percent of the lake contains permanently flooded timber and the average depth is only 4.5 feet. Within three years after impoundment of Iatt Lake in 1956, aquatic weeds began causing a severe access problem to anglers and other recreational boaters. The lake contains dense submerged aquatic vegetation, which impedes fishing and boat travel, and allows too many small fish to survive by reducing predation by larger fish.

The Louisiana Department of Wildlife and Fisheries (LDWF) previously attempted winter drawdowns to reduce aquatic vegetation. That program reportedly led to flooding of soybean fields in the recently cleared

flood plain downstream between the spillway and U.S. Highway 71. Legal action by affected farmers reportedly suspended this management technique. On August 15, 1981, another drawdown was initiated but at a very slow rate; the lake level was kept several feet below spillway level throughout the fall and winter season. LDWF personnel have complained that it is difficult to keep the lake sufficiently dewatered due to the necessity of making slow releases.

Fishery Resources

The sport and commercial fishery resources of the study area are restricted to Iatt Lake, Bayou Rigolette, Bayou Darrow, and numerous other streams and channels. Fish species collected in Bayou Rigolette by Corps and FWS biologists during the period October 19-22, 1981, include gizzard shad, longnose gar, spotted gar, shortnose gar, river carpsucker, carp, bowfin, freshwater drum, flathead catfish, channel catfish, white crappie, and largemouth bass. Sport fishing, particularly for yellow bass, is common at the Bayou Rigolette floodgate. Commercial fishing is reported to be especially good in the years when Red River backwaters enter Bayou Rigolette through the floodgate. Sport fishing in Bayou Rigolette is generally limited because of inadequate fisherman access.

In years when springtime upstream migration into seasonally-flooded bottomland hardwoods and swamps (like those found along Bayou Rigolette) is possible, such areas act as important feeding, spawning, and nursery areas for many species of fish. During floods, large quantities of organic matter are washed out of inundated woodlands and transported to larger downstream waterbodies, thereby supporting a detritus-based food chain. The food chain in deep turbid streams like the ..ed River is largely dependent on detritus rather than light-dependent phytoplankton.

Iatt Lake is a moderately good sport fishing lake providing good catches of largemouth bass, bluegill, redear sunfish, and channel catfish. There are both public and private boat-launching ramps on the lake.

Although sport and commercial fishing in the area is severely limited by access, the potential harvest is significant and was quantified using the methodology described in Appendix B. The potential sport fishing value of the study area is estimated at about 26,100 man-days having a value of over $84,800 on an average annual basis. The total potential commercial fishery is valued at $20,750 annually.

Wildlife Resources

Amphibians and Reptiles

Limited numbers of the American alligator are present in the area and may be harvested for sport and commercial purposes under a closely regulated management program. The alligator snapping turtle, common snapping turtle, smooth softshell turtle, spiny softshell turtle, and

bullfrog are likely to occur in or adjacent to the study area and are taken for sport or commercial purposes.

Birds

Because of the migratory nature of birds, abundance and presence of most species fluctuates seasonally. Generally, species diversity also fluctuates directly with diversity in vegetative structure such that few species are found in the cleared habitats and more in the riparian and bottomland hardwood habitats.

Migratory waterfowl are abundant winter residents of most intermittently or permanently flooded habitats in the study area. Common dabbling ducks include mallard, green-winged teal, blue-winged teal, pintail, gadwall, and American wigeon. Many wintering ducks feed in flooded agricultural fields during early morning and late afternoon and concentrate in flooded bottomland hardwood areas to rest and preen.

Wood ducks utilize the area on a year-round basis and are largely dependent upon forested wetlands. Wood ducks nest in tree cavities or nest boxes and rear their broods in flooded swamps and streams where the water surface is covered by the forest canopy or other overhanging vegetation. Good water quality that is conducive to high insect production in brood rearing areas is also essential for successful reproduction. During fall and winter, migrant and resident wood ducks depend on streams and flooded bottomland hardwood tracts for food and cover, feeding in flooded agricultural areas to a limited degree.

Other game birds in the study area include mourning dove, bobwhite, common snipe, eastern wild turkey, and American woodcock. Mourning dove, bobwhite, and common snipe are commonly found in agricultural areas and/or field edges. The eastern wild turkey and American woodcock are more common in forested areas.

Numerous other non-game birds are also commonly found in the study area. Wading birds such as great blue heron, little blue heron, and common egret occur in the shallow water edges of area streams. The prothonotary warbler, pileated woodpecker, red-headed woodpecker, barred owl, Cooper's hawk, brown creeper, and wood thrush are all common in the riparian and forested habitats of the study area. The mockingbird, loggerhead shrike, brown-headed cowbird, European starling, eastern meadowlark, indigo bunting, and American kestrel are all common in fields, openings, and roadsides throughout the study area.

Mammals

Many of the mammals occurring in the study area are valuable from a sport or commercial standpoint. The white-tailed deer is the only big game species present. Bottomland hardwoods support high deer populations. Gray squirrel, fox squirrel, eastern cottontail, swamp rabbit, and northern raccoon are found primarily in the riparian or forested habitats and other undeveloped areas throughout the study

area and are sought for sport purposes. Furbearers that occur in the study area include the coyote, bobcat, North American mink, northern raccoon, nutria, muskrat, striped skunk, gray fox, red fox, and opossum.

Species of Special Emphasis

The project area supports eight species considered by the Fish and Wildlife Service (FWS) to be National Species of Special Emphasis (Federal Register, Vol. 48, No. 237, December 8, 1983). These species are coyote, wood duck, black duck, mallard, pintail, American woodcock, mourning dove, and American alligator. Also likely to be present are eight additional species highlighted by the Regional Resource Plan for the Southeast Region, these include wood stork, red-headed woodpecker, pileated woodpecker, eastern bluebird, starling, common grackle, cowbird, and red-winged blackbird.

Endangered Species

By letter dated September 8, 1983, to the Corps, the FWS's Endangered Species Office in Jackson, Mississippi, indicated that there are no records of endangered, threatened, or proposed species, or their Critical Habitat occurring in the study area.

EVALUATION METHODOLOGY

An assessment of project-related impacts to fish and wildlife resources was completed using several analyses, including habitat acreage, the FWS's Habitat Evaluation Procedures (HEP), and man-day/monetary evaluation. Also evaluated were the impacts of the proposed project on habitats of particular importance to wintering waterfowl; this analysis was based on project-induced changes in the number of acre-days of flooding during the waterfowl wintering period. All analyses addressed the period from the beginning of construction to the end of project life. The fundamental tool used for assessing impacts on fish and wildlife is the estimation of project-related changes in acreages of specific habitats, as compared to habitat trends expected to occur without the proposed project. These data form the basis of the other evaluations conducted. For baseline data, the study area was outlined on recent aerial photography, and habitat types within the area were planimetered and provided to FWS by the Corps.

The FWS calculated induced clearing using a combination of methodologies described by the Corps in the McKinney Bayou, Arkansas and Texas, draft General Reevaluation Report, published in 1983, and by the FWS in a letter to the Corps dated September 21, 1983. The FWS method predicted the anticipated clearing of 75 percent of the forested land that will be removed from the 3-year flood plain via project implementation. This forested acreage, virtually all of which is classified as prime farmland, was assumed to be converted to

agricultural land within 10 years after project benefits begin to accrue.

The Corps disagrees with this method of determining future land use and asserts that there would be no conversion of forested habitat to cleared habitat as a result of project implementation and subsequent reduction in flood frequency. Because of this disagreement the results of habitat acreage, HEP, and man-day/monetary analyses are reported for the FWS's and Corps' respective methodologies for determining induced clearing. A complete discussion of the HEP and man-day/monetary methodologies is provided in Appendices A and B.

PROJECT IMPACTS

The principal project impacts on fish and wildlife resources would result from the conversion of forested habitat to agricultural land and, with Plan 6A, loss of riparian habitat due to clearing and snagging. Project impacts on acreages of specific habitat types are summarized in Table 2. Another impact of serious concern is the project-induced reduction of winter flooding of forested and agricultural lands. This reduction in winter flooding would adversely affect migratory waterfowl using those lands. Two habitat types that will be created by project implementation are altered riparian and cleared-and-snagged riparian. Altered riparian habitat includes the area impacted by construction and maintenance of the proposed new channel and floodgates. This area, which will be kept in an early stage of vegetational succession by annual maintenance, is expected to be of low value to wildlife. Cleared-and-snagged riparian habitat will be created by the clearing and snagging operation proposed with Plan 6A. This habitat type includes the channel, stream banks, berm, and disposal areas along the impacted streams. The area affected by clearing and snagging will be maintained every 12 years. Therefore, some recovery of habitat value is expected to occur between maintenance operations. Clearing and snagging with Plan 6A is expected to cause the average annual loss of 491 acres of riparian habitat. Plan 6A will also result in the conversion of 1,685 acres of bottomland hardwood habitat to cleared land (1,650 acres) and altered riparian habitat (35 acres).

Implementation of Plan 19C is expected to cause the conversion of only 20 acres of bottomland hardwoods to altered riparian habitat. Plan 5C impacts include the conversion of 1,070 acres (average annual) of bottomland hardwood habitat to cleared (1,050 acres) and altered riparian habitat (20 acres).

Fisheries Impacts

The HEP have not been finalized for assessment of project impacts on warmwater stream fishery resources. However, a man-day/monetary analysis of project impacts on sport and commercial fishery resources was completed (Appendix B).

Table 2. Comparison of habitat acreages under future without-project (FWOP), future with Plan 5C (FWP5C), future with Plan 6A (FWP6A), and future with Plan 19C conditions (FWP19C) for the Aloha-Rigolette Area, Louisiana, study area.

Project condition	Habitat Acreages[1]					
	Cleared	Riparian	Altered riparian[2]	Cleared and snagged riparian[3]	Bottomland hardwood	Total
FWOP	24,051	2,913	0	0	15,027	41,991
FWP5C	25,101	2,913	20	0	13,958	41,992
FWP6A	25,701	2,422	35	491	13,342	41,991
FWP19C	24,051	2,913	20	0	15,007	41,991
Net change						
FWOP vs FWP5C	+1,050	0	+20	0	-1,070	
FWOP vs FWP6A	+1,650	-491	+35	+491	-1,685	
FWOP vs FWP19C	0	0	+20	0	-20	

1. All acreages displayed in this table represent the average annual habitat acreage in the project area from the beginning of construction to the end of the project life; minor differences in totals represent rounding errors.

2. Altered riparian habitat is that habitat adjacent to the proposed floodgate and channel that will be mowed and maintained annually.

3. Cleared-and-snagged riparian is that habitat which will be modified and maintained on a 12-year basis by clearing and snagging operations.

Streams, backwater areas, and Iatt Lake support the only significant fishery resources in the study area. Detailed information on the fishery resources of area streams is not available. However, studies of similar streams in Louisiana and other states, and conversations with experienced field biologists indicate that these areas are highly productive and support a high standing crop of sport and commercial fishes. As previously mentioned, Bayou Rigolette and other area streams have been modified by a previous Corps project. Therefore, fisheries production under existing conditions is somewhat below optimum and is not expected to improve or change substantially under FWOP conditions, or with Plan 5C or Plan 19C. However, the extensive clearing and snagging as proposed with Plan 6A is expected to be extremely damaging to fishery resources.

Estimates of project impacts on sport and commercial fishes (summarized in Table 3) are based on anticipated reductions in biomass (poundage) of selected fish groups after project completion. These impacts are most easily expressed in terms of pounds of available fish, potential man-days of sport fishing, and potential monetary value of the sport and commercial fishery.

The net impacts of Plans 5C and 19C on fishery resources are expected to be nearly identical. Because additional channel will be constructed with those plans, a slight increase in the total poundage, potential man-day usage, and monetary value of the sport and commercial fishery is expected. Implementation of Plan 6A is expected to reduce the average annual poundage of available sport fish and total fish by 90 percent and 50 percent, respectively. This loss of available fish is, in turn, expected to reduce the potential sport fishing in the study area by nearly 8,405 man-days annually. Similarly, the average monetary value of the sport and commercial fisheries is expected to decrease by about $32,422 annually (Table 3).

With the increased pool elevations resulting from operation of the completed Lock and Dam No. 2 for the RRWW project, minimum water levels in Bayou Rigolette are expected to be raised by as much as 5 feet. The fishery resources of the study area are expected to improve as a result of the increased volume of water in the area waterways, but are not expected to disproportionately change the impacts associated with any of the project alternatives.

Wildlife Impacts

Project related impacts to wildlife resources were assessed via use of the FWS's HEP, a man-day/monetary analysis, and an analysis of project-related changes in the numbers of acre-days of flooding. The results of these analyses are provided in Appendices A and B and summarized below.

Of the species evaluated in the HEP analysis, white-tailed deer, gray squirrel, prothonotary warbler, and barred owl are the species expected to be negatively impacted by Plan 5C, Plan 6A would adversely affect all evaluation species except mourning doves. Plan 19C would

Table 3. Comparison of man-day/monetary values of the fish and wildlife resources in the Aloha-Rigolette Area, Louisiana, study area under future without-project (FWOP), future with Plan 5C (FWP5C), future with Plan 6A (FWP6A), and future with Plan 19C (FWP19C) conditions.[1]

Project condition	Activity	Man-day Value	Man-day Change[2]	Monetary value	Monetary change[3]
FWOP	Sport fishing	26,103		$84,835	
	Commercial fishing[4]			20,756	
	Sport hunting[5]	31,595		220,578	
	Trapping			18,298	
	WOR[6]	8,971		29,063	
	Total	66,669		373,530	
FWP5C	Sport fishing	26,119	16	84,889	$54
	Commercial fishing[4]			20,797	41
	Sport hunting[5]	30,391	-1,204	210,355	-10,223
	Trapping			17,208	-1,090
	WOR[6]	8,435	-536	27,330	-1,733
	Total	64,945	-1,724	360,579	-12,951
FWP6A	Sport fishing	17,698	-8,405	57,518	-27,317
	Commercial fishing[4]			15,651	-5,105
	Sport hunting[5]	29,194	-2,401	201,034	-19,544
	Trapping			16,120	-2,178
	WOR[6]	7,902	-1,069	25,602	-3,461
	Total	54,794	-11,875	315,925	-57,605
FWP19C	Sport fishing	26,119	16	84,889	54
	Commercial fishing			20,797	41
	Sport hunting	31,585	-15	220,429	-149
	Trapping			18,278	-20
	WOR	8,960	-6	29,031	-32
	Total	66,664	-5	373,424	-106

Continued

Table 3. Continued

1. Data displayed in this table are taken from Tables B-3 and B-9, Appendix B.
2. Man-day change is calculated by subtracting the man-day value for a given activity under FWOP conditions from the man-day value for that same activity under a future with-project condition.
3. Monetary change is calculated by subtracting the monetary value for a given activity under FWOP conditions from the monetary value for that same activity under the future with-project condition.
4. Commercial fishing includes both the commercial and shad fishery values presented in Appendix B.
5. Sport hunting includes small-game hunting, big-game hunting, and waterfowl hunting values presented in Appendix B.
6. WOR = wildlife-oriented recreation.

cause minor losses of habitat value for all species evaluated except mourning dove (Table 4).

The results of the man-day/monetary analysis are summarized in Table 3. Plan 5C is expected to cause the average annual loss of 1,204 man-days of sport hunting valued at over $10,221 and 530 man-days of WOR valued at almost $1,733. Plan 6A would be much more destructive to wildlife resources; that plan would cause the average annual loss of 2,401 man-days of sport hunting valued at almost $19,544 and about 1,069 man-days of wildlife-oriented recreation (WOR) valued at $3,461. The primary effects of Plan 19C would be a minor reduction in sport hunting and WOR.

Trapping would be negatively impacted by all plans. The average annual monetary value of the fur harvest in the study area would be reduced by $1,090 with Plan 5C, $2,178 with Plan 6A, and only $20 with Plan 19C.

Project impacts on wintering waterfowl were estimated by comparing the average annual acre-days of flooding in the project area with and without project implementation (Table 5). Acre-days is the product of the average annual acres and the average annual days of flooding during the waterfowl wintering period (i.e., November 1 to March 1).

Estimates of the average annual acres flooded and the number of days flooded were developed according to the reach to be affected (i.e., Bayou Dugrappe and Bayou Rigolette) and the habitat type (forested and cleared) flooded during November 1 to March 1. Implementation of either Plan 5C or 19C would reduce average annual flooding in the Bayou DuGrappe reach by 2,574 acre-days, and in the Bayou Rigolette reach by 37,800 acre-days. This would result in a total loss of 40,374 acre-days for Plans 5C and 19C. Implementation of Plan 6A would eliminate flooding in the Bayou DuGrappe reach, representing a loss of 32,076 acre-days. Winter flooding in the Bayou Rigolette reach with Plan 6A would be reduced by 45,000 acre-days. Plan 6A would cause a total loss of 77,076 acre-days of winter flooding. Therefore, project impacts associated with Plan 5C or 19C would be less damaging to wintering waterfowl than the impacts associated with Plan 6A.

<u>Impact Analyses using Corps' Land Use Assumptions</u>[1]

As stated above, the Corps disagreed with the FWS's projection of land use with Plan 5C and Plan 6A. The Corps does not anticipate any clearing of forested land as a result of project implementation. Using the Corps' methodology, the impacts associated with Plan 5C and Plan 19C are the same.

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1. For brevity, tables were excluded from this section; however, calculations and numerical expressions summarized in this section are on file in the FWS's Lafayette, Louisiana, field office.

Table 4. Comparison of average annual habitat units (AAHU's) under future without project (FWOP), future with Plan 5C (FWP5C), future with Plan 6A (FWP6A), and future with Plan 19C (FWP19C) conditions for the Aloha-Rigolette Area, Louisiana, study[1].

	AAHU's						
Evaluation species	FWOP	FWP5C	FWOP vs FWP5C[2]	FWP6A	FWOP vs FWP6A[2]	FWP19C	FWOP vs FWP19C[2]
Dove	23,441	24,286	+845	24,729	+1,288	23,441	0
Deer	19,164	18,453	-711	17,741	-1,423	19,148	-17
Squirrel	14,925	14,087	-838	13,446	-1,479	14,909	-16
Mink	4,577	4,602	+25	4,381	-196	4,575	-1
Wood duck	3,926	3,931	+4	3,719	-208	3,925	-1
Warbler	5,194	5,171	-23	4,926	-268	5,192	-2
Barred owl	18,466	17,724	-742	16,901	-1,565	18,451	-15
Total	89,692	88,254	-1,439	83,843	-3,851	89,641	-52

1. Data summarized in this table are taken from Table A-4, Appendix A.

2. The change in AAHU's for each species were calculated by subtracting FWOP AAHU's from the appropriate with-project AAHU's. This calculation was made prior to rounding to the nearest whole number; therefore, the change in AAHU's may not represent the exact change in AAHU's as displayed in this table.

Table 5. Comparison of acre-days of flooding during the waterfowl wintering period in the Aloha-Rigolette Area, Louisiana, study area under future-without project (FWOP), future with Plan 5C or 19C (FWP 5C/19C) and future-with Plan (FWP6A) conditions.

Condition	Habitat Type	Number of days *flooded during* waterfowl wintering period (Nov. 1-Mar.28)		Number of acres flooded during waterfowl wintering period (Nov. 1- Mar. 1)	Acre-days[1]	*Change in* Acre-days due to project
FWOP	Bayou Dugrappe	11				
	cleared			2,067	22,737	
	forested			849	9,339	
			Total	2,916	32,076	
	Bayou Rigolette	18				
	cleared			1,000	18,000	
	forested			3,294	59,292	
			Total	4,294	77,292	
FWP5C/19C	Bayou Dugrappe	11				
	cleared			1,850	20,350	-2,387
	forested			832	9,152	-187
			Total	2,682	29,502	-2,574
	Bayou Rigolette	18				
	cleared			0	0	-18,000
	forested			2,194	39,492	-11,800
			Total	2,194	39,492	-37,800
FWP6A	Bayou Dugrappe	11				
	cleared			0	0	-22,737
	forested			0	0	-9,339
			Total	0	0	-32,076
	Bayou Rigolette	18				
	cleared			0	0	-18,000
	forested			1,794	32,292	-27,000
			Total	1,794	32,292	-45,000

1. Acre-days is the product of the number of days flooded during the wintering waterfowl period and the number of acres flooded during that same period.

The HEP analysis indicates that the impacts of Plan 5C would be much less than the impacts resulting from Plan 6A. Only Plan 6A would significantly impact all but one evaluation species (i.e., mourning dove).

The man-day/monetary evaluation also indicates that Plan 6A would result in much greater adverse impacts than Plan 5C. Construction and maintenance of Plan 5C is expected to reduce the average potential man-day usage of fish and wildlife resources by 1,724 man-days and the monetary value of the sport and commercial fish and wildlife resources by $12,951 annually. Construction and maintenance of Plan 6A is expected to reduce the average potential man-day usage of those resources by 11,875 man-days and their total sport and commercial value by $57,605 annually.

DISCUSSION

General

Based on input from the public and various local, State, and Federal agencies (including the FWS), the following planning objectives were established by the Corps for this project:

1. reduce flood losses in the Aloha-Rigolette area to increase agricultural production;

2. stem the decline of and where possible enhance bottomland hardwoods located in the alluvial floodplain of the Aloha-Rigolette area;

3. protect and where possible enhance the fish and wildlife resources in the Aloha-Rigolette area;

4. protect and where possible enhance existing wetlands in the Aloha-Rigolette area;

5. improve the water quality of Bayou Rigolette and its tributaries within the alluvial floodplain;

6. improve water-oriented recreational opportunities in the Aloha-Rigolette area; and

7. preserve and avoid contributing to the destruction of archeological, historical, and paleontological resources in the Aloha-Rigolette area.

The above objectives were established to guide planners toward the development of project alternatives that will satisfy the perceived needs in the study area. These objectives also reveal that prior degradation of fish and wildlife habitat is perceived as a serious

problem in the study area. Five of the seven planning objectives deal directly with the improvement or protection of habitat and other ecological resources. Essential to the fulfillment of these five planning objectives is the preservation and/or enhancement of bottomland hardwood and riparian habitats in the study area.

The value of forested habitats to fish and wildlife and water quality has been well documented. Stauffer and Best (1980) reported that floodplain woodland habitats supported about three times more non-game bird species in greater densities than did herbaceous habitats and that non-game bird species richness increased with the width of riparian habitat. Data collected by Gray and Arner (1977) indicate that riparian habitat for beaver, muskrat, raccoon, and mink remained damaged by channelization 55 years after project completion, even where habitat adjacent to the stream was allowed to recover. In a comparison of habitat utilization by white-tailed deer, Zwank et al. (1979) concluded that bottomland hardwoods in the midwest are utilized throughout the year and that conversion of these forest habitats to agriculture constitutes a threat to viable deer populations.

Migratory waterfowl are also dependent upon the bottomland hardwood and riparian habitats and winter wetlands characteristic of the study area. Studies and literature surveys conducted by Frederickson (1980) and Heitmeyer and Frederickson (1981) document the dependence of mallards and wood ducks on foods rich in the lipids and proteins essential for successful egg development and reproduction. Such nutrients are available in the natural foods found in flooded bottomland hardwood forests, but may be absent or less abundant in foods available in agricultural areas.

Farming practices, flood control, and drainage programs have a major effect on the relationship between rainfall and the natural cycle of temporary winter flooding. FWS studies are being conducted to document the value of such winter wetlands to migratory waterfowl. Thus far, study results indicate that about 10 percent more birds are attracted to the lower Mississippi Valley during years of heavy rains and temporary flooding and, from dry to wet winters, the weights of mallards may fluctuate by as much as 10 percent. Because heavier birds are expected to survive and reproduce more successfully, the increased habitat provided in flooded fields and bottomland hardwoods during wet winters is thought to be responsible for consistently higher mallard recruitment and survival of juvenile birds observed following wet winters.

Preliminary conclusions drawn from the referenced FWS studies are that winter precipitation and shallow water (more than temperature) affect both regional and local distribution of mallards during winter, especially young birds. As drainage efforts continue, the Mississippi Alluvial Valley will experience drier conditions, attract fewer mallards, and these mallards will concentrate in higher densities on the remaining wetlands. Accordingly, the waterfowl population and the number of locations suitable for associated recreational opportunities will decline.

Flood control projects in the Mississippi Alluvial Valley ordinarily facilitate the clearing and conversion of bottomland hardwoods to agricultural row-crop production. Removal of natural vegetation and current agricultural practices severely affects wood duck reproduction in these areas. DiGuilio (1978) conducted a study of wood duck brood usage of agricultural field wetlands in Concordia Parish, Louisiana. He found that, with the addition of suitable nesting cavities (nest boxes), wood ducks would nest in isolated wetlands in agricultural fields, but did not remain in these areas to raise their broods. Adequate food, cover, and water are critical to the survival of ducklings. However, shallow waters in these agricultural field wetlands are typically devoid of vegetation and highly turbid, which in turn severely limits aquatic insect populations that normally fulfill the high protein needs of ducklings. DiGuilio concluded that habitat disturbances extend beyond the destruction of nest sites used by these cavity-nesting species and include brood-rearing components. He recommended protection of forested wetlands in agricultural areas from disturbances such as silt erosion or, if possible, protection of the remaining forested areas in the Mississippi Alluvial Valley.

From these studies, it is apparent that flood control projects adversely affect waterfowl reproduction, populations, and winter distribution. The acre-day analysis (Table 5) quantifies those impacts and is the best methodology available at this time for that purpose.

Conversion of forested habitats to more intensive agricultural uses has a deleterious effect on water quality. An increase in cropland acreage ordinarily increases the amount of pesticides used, increases the amount of erosion, and decreases the acreage of permanently vegetated land that acts to absorb more rainfall and filter out sediments and toxic substances. Thus, turbidity and toxic materials in aquatic systems are increased. The resulting degradation of water quality adversely impacts aquatic resources (such as fish) and human usage of those resources (Schmitt and Winger 1980).

Whenever bottomland hardwood and riparian habitats are converted to row-crop agriculture or destroyed by drainage projects, the carrying capacity for wildlife diminishes proportionately (Yancey 1969). The clearing and conversion of these habitats to agricultural row-crop production has been devastating. In the Mississippi Alluvial Valley during the period 1937 to 1977, bottomland hardwoods diminished from 12 million acres to only about 5.2 million acres. Annual clearing rates in that area have approached 300,000 acres. In Rapides Parish, where several flood control projects have facilitated the conversion of bottomland hardwoods to agriculture, nearly 65 percent of the 83,000 acres of bottomland hardwoods remaining in 1957 had been eliminated by 1977.

In a study of bottomland hardwood habitat loss in the lower Mississippi Alluvial Valley, completed for the FWS, MacDonald et al. (1979) concluded:

Although it cannot be stated unequivocally that the completion of COE (Corps of Engineers) projects and PL-566 (Soil Conservation Service) projects caused the depletion of bottomland hardwood stands, it is noted that 32 of the 33 counties in the study area with initiated and completed projects had corresponding net losses in bottomland hardwood forests. Furthermore, counties with higher losses tended to be those counties that had several completed projects.

Therefore, it is assumed that much of the wetland and forested habitat degradation in the study area has, to a large degree, been the result of prior Corps projects. Furthermore, without a habitat preservation provision, such as the easement included in Plan 19C, additional flood reduction is expected to reduce the average annual area flooded and contribute significantly to the clearing of additional bottomland hardwoods.

Both Plan 5C and Plan 6A are expected to cause significant adverse impacts to bottomland hardwood and wetland habitats, water quality, fish and wildlife resources, and wildlife-oriented recreational opportunities in the study area. These negative impacts are contrary to five of the seven planning objectives originally established for this study. The only plans carried into the late planning stages that had a favorable benefit:cost ratio (personal communication with Wilbert Payne, Project Manager, New Orleans District, Corps of Engineers on September 29, 1983) and will fulfill the planning objectives are Plans 19C and 16A; Plan 16A called for floodplain zoning. With implementation of Plan 19C, existing floodgate capacity would be increased six-fold, and it would seem that flood protection would be provided to existing agricultural and residential areas and, with the addition of boat launches and erosion prevention measures, all other planning objectives would also be fulfilled.

Of special concern to the FWS is the clearing and snagging of about 25 miles of streams proposed in Plan 6A; this would be accomplished by removal of all instream cover and a substantial amount of stream-bank vegetation. Therefore, this proposal would have similiar impacts to fish and wildlife resources and water quality as stream channelization, an activity that has been consistently opposed on a nationwide basis by the FWS. Although there may be a need to clear obstructions from the upstream side of certain bridges in the study area, the FWS questions the need to initiate channel modification on the scale proposed in Plan 6A. If such a proposal is deemed necessary at some future date, adherence to the guidelines set forth by McConnel et al. (1980) in "Stream Renovation Alternatives: The Wolf River Story" would reduce adverse impacts on fish and wildlife resources.

As presently described, implementation of Plan 6A would require additional mitigation for project-related losses of fishery resources. Potential mitigation measures for such losses involve the purchase of necessary flowage easements to facilitate the periodic drawdown of Iatt Lake for aquatic weed control and fishery management, and the provision of improved instream flows for the downstream portion of Bayou Rigolette. Under current conditions, cropland adjacent to Bayou

Rigolette and downstream from Iatt Lake floods whenever the lake levels are dropped; this had led to landowner objections to such drawdowns. Less-than-optimum releases from Iatt Lake are also impeding optimum aquatic productivity in downstream areas.

As discussed previously, flood control projects, such as this, have a major adverse effect on the natural cycle of winter flooding and, therefore, on the regional and local waterfowl populations. Mitigation for such impacts may involve purchase of fee title or easements on an area which can be flooded during the waterfowl wintering period.

Mitigation and Compensation

To offset unavoidable project-induced habitat losses, mitigation measures should be provided for all quantifiable impacts. The FWS's mitigation policy, published in the Federal Register in 1981, requires use of the HEP by FWS biologists, where appropriate, to determine mitigation needs. The FWS mitigation policy further directs the FWS to base mitigation planning goals and recommendations on four resource categories. The habitat types to be affected by the plans still under consideration include bottomland hardwood, stream channel, riparian and cleared agricultural lands that experience winter flooding. Based on the high value of these habitat types to fish and wildlife and the rapid clearing/channelization rate that may soon make these habitats relatively scarce, bottomland hardwood, stream channel, and riparian habitats were placed in Resource Category 2. Because cleared lands that experience winter flooding are often of high value to wintering waterfowl and because such flooding is being diminished by flood control and drainage project throughout the Mississippi Valley, we have also designated this habitat type as Resource Category 2. That designation is assigned to habitats that are of high value for evaluation species and are relatively scarce or becoming scarce on a national basis or in the ecoregion section. The mitigation goal for Resource Category 2 habitats is that there should be no net loss of in-kind habitat value. Non-flooded cleared lands are of low value to wildlife, and were placed in Resource Category 4. The mitigation goal for that category is to minimize loss of habitat value.

Despite measures taken to minimize and/or rectify adverse impacts, all of the plans now being considered would still result in unavoidable impacts to wildlife resources; these unavoidable impacts would require implementation of compensation measures. Compensation normally entails the purchase of similar type habitat and the management of the purchased lands to offset project-induced losses of biological productivity.

Regardless of which compensation approach is ultimately recommended to Congress, the proposal should include establishment of additional bottomland hardwood and wooded swamp wildlife values to fully offset project impacts on those nationally significant and threatened habitat types. The proposal should also include provisions for replacing any project-induced reduction of winter flooding of forested lands and seasonally flooded agricultural lands. Any losses of stream channel habitat should also be fully mitigated.

Compensation Determination

In-kind replacement of losses to each of the negatively impacted evaluation species requires the precise replacement of AAHU losses, shown in Table 3. In practice, it is rarely possible to precisely offset habitat unit losses for each species or by habitat acres. Creation and/or preservation of habitat within a mitigation area will usually over-compensate for some species and under-compensate for other species. Therefore, selection of an area to adequately compensate for the total AAHU losses is based on the preservation potential and/or management potential of that area for the impacted species and habitat types.

The mitigation plan proposed in this report involves the purchase and management of a cleared agricultural area, and a flood easement over a portion of a wooded riparian area. The proposed mitigation area is located southwest of Iatt Lake, adjacent to the existing Iatt Lake Game and Fish Preserve. Management would be geared toward increasing the density of an evaluation species (except the mourning dove, which showed an increase in AAHUs with all plans) and overall wildlife diversity. This would be accomplished by reforestation, maintenance of forest openings, and water management.

Reforestation would involve planting of preferred mast bearing trees, such as Nutall oak, swamp chestnut oak, and water oak. About 5 percent of the area would be devoted to 2- to 3-acre openings scattered throughout the area. These openings would be planted in various grasses and big-seeded annuals in the late spring (May to June) and wheat and clover in the fall (late September to October). The spring planting would be done over the entire area. However, in the fall these openings would be disked so that fall-planted strips would alternate with spring-planted strips.

Water management would involve a drawdown of Iatt Lake to maintain and/or create winter wetlands in the downstream floodplain of Bayou Rigolette. Drawdowns could also improve stream flows and associated fish habitat suitability in the stream reaches below the dam. The shallow-water areas created would maintain winter wetlands for migratory waterfowl and brood-rearing areas for resident wood ducks. In addition to creating winter wetlands, periodic drawdowns of Iatt Lake would benefit the fishery resources of the lake by controlling the aquatic vegetation and facilitating removal of stunted sunfishes by larger predators.

Based on the procedure defined in the HEP for mitigation, we estimate that management of approximately 1,423 acres, in the manner described above, would be required to mitigate for wildlife habitat losses associated with Plan 5C, and 2,752 acres for Plan 6A. More intensive management of the proposed mitigation area may result in a reduction in the amount of acres required. Additional management measures directed toward improving habitat for mink may also reduce the acres required to compensate for Plan 6A.

Plan 19C calls for acquisition of a non-development easement over all wooded lands within the with-project 5 years floodplain, however, mitigation for winter water losses should be provided. This may simply involve construction of some type of water control device on Bayou Rigolette to provide flooding on the easement lands during the control wintering period.

Mitigation for fisheries losses would be required with Plan 6A. The purchase of flowage easements along Bayou Rigolette would facilitate drawdown of Iatt Lake for aquatic weed control and improved fishery yields. According to preliminary figures provided by the Corps, such a plan would increase the monetary value of Iatt Lake by $74,444. Provision of a schedule of flow releases from Iatt Lake dam to improve aquatic productivity in Bayou Rigolette might also provide mitigation of stream fishery losses associated with Plan 6A. Compensation needs for the aquatic (fishery) losses associated with this plan could be substantially reduced if the approach was scaled down to allow maintenance of more instream and streambank cover.

Mitigation for waterfowl losses would be accomplished via flooding of the required amount of acres during the critical waterfowl wintering period (November 1 to March 1). Based on the acre-day analysis (Table 5), 336 acres would have to be flooded for 120 days (i.e., 40,374 acre-days) to mitigate for acre-day losses associated with Plan 5C and 19C, while 642 acres of land would have to be flooded throughout the 120-day wintering period (i.e., 77,076 acre-days) to mitigate for such losses with Plan 6A.

Land acquisition and construction of mitigation features should begin simultaneously with right-of-way acquisition and construction of flood control features. Our preliminary estimate of costs and benefits of mitigation features are listed below; once more accurate costs estimates are developed, they should be included in any report submitted to Congress for authorization and funding.

According to information obtained from the Corps, mitigation cost estimates are based on an acquisition cost of $1,800 per acre; an estimated $15,000 for the first 1,000 acres, plus $5,000 for each additional 1,000 acres for initial timber stand improvement, fencing, creation of openings, and installation of water management structures; and an annual management cost of $7 per acre. Mitigation costs would vary depending on the flood control plan implemented. The estimated first costs for implementation of mitigation vary from over $2.6 million to compensate for wildlife losses associated with Plan 5C to nearly $5 million to compensate for wildlife losses associated with Plan 6A. The annual operation and maintenance costs were also calculated. Mitigation would cost an estimated $9,961 annually to fully compensate for Plan 5C and an estimated $19,264 annually to fully compensate for Plan 6A. Contingencies, interest, and amortization were not included in this estimate.

RECOMMENDATIONS

In view of the above considerations, the FWS recommends that the following measures be taken in the interest of fish and wildlife conservation:

1. Plan 19C should be the alternative selected for implementation, and should be modified to provide for 40,374 acre-days of winter (November 1 - March 1) flooding to fully compensate for project-induced losses of waterfowl wintering habitat.

2. If Plan 5C is selected, mitigation should include the purchase and management, in the manner described above, of at least 1,425 acres of cleared and riparian habitats. At least 337 of those acres should be flooded for 120 days during November 1 to March 1 to provide at least 40,374 acre-days of flooding for wintering waterfowl.

3. If Plan 6A is selected, mitigation should include the purchase and management of an estimated 2,752 acres of cleared and riparian habitats, as well as the purchase of flowage easements to facilitate water-level management in Iatt Lake and improve aquatic habitat quality in Bayou Rigolette. At least 642 of those acres purchased for mitigation purposes should be flooded for 120 days during November 1 to March 1 to provide for a minimum of 77,076 acre-days of winter flooding for wintering waterfowl.

4. Mitigation measures should be implemented simultaneously with other project features.

5. Administration and management of lands acquired in fee simple should be in accordance with the General Plan process contained in Section 3b. of the Fish and Wildlife Coordination Act.

6. The initial development, replacement, and annual operation and maintenance costs for the mitigation features shall be provided by the Corps as an integral project expense.

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ALOHA-RIGOLETTE AREA, LOUISIANA, STUDY

APPENDIX A

HABITAT EVALUATION PROCEDURES (HEP) ANALYSIS AND RESULTS

The Fish and Wildlife Service's (FWS) Habitat Evaluation Procedures (HEP) were developed to help document the quality and quantity of available habitat for fish and/or wildlife species in a given area. Using the HEP, habitat quality and quantity can be measured for baseline conditions and predicted for future without-project (FWOP) and future with-project (FWP) habitat conditions. This standardized, species-based methodology allows a numeric comparison of each future condition and hence provides an estimate of project-induced impacts on fish and wildlife resources. The 1980 version of HEP, which has become the most widely accepted technique for assessing wildlife impacts, was modified and used for this project.

Cover types used in the HEP analysis include riparian, cleared (agricultural), bottomland hardwood, altered riparian, and cleared and snagged riparian. These habitats are described in the main report. The Corps of Engineers' New Orleans District (Corps) provided the estimates of habitat acreages within the study area under existing conditions. Habitat acreages within the study area under FWOP conditions are based on these baseline acreages and information provided by area Soil Conservation Service personnel. Under FWOP conditions, no land-use changes are expected in the project area. However, habitat acreages are expected to change under FWP conditions. Acreage impacts associated with the construction and maintenance of various project alternatives are included in the acreage totals displayed in Tables A-1 and A-2. In addition to impacts associated with project construction, project implementation is expected to lower the 3-year flood plain elevation. Using the methodology discussed in the "Evaluation Methodology" section of this report, it was assumed that 75 percent of the forested land removed from the 3-year flood plain will be cleared for agricultural development within 10 years after project implementation (Tables A-1 and A-2).

Several species that are economically important and/or which represent various trophic levels of wildlife utilizing study area habitat types were selected as evaluation elements. Species selected were mourning dove, white-tailed deer, gray squirrel, North American mink, wood duck, prothonotary warbler, and barred owl. These species were used to evaluate all habitat types in the project area. Several sample sites within each of the three cover types identified were inspected during the period July 19-20, 1983, by a team of biologists representing the Corps, the Louisiana Department of Wildlife and Fisheries, and FWS.

In the strictest application of HEP, habitat suitability is based on actual field measurements of various parameters that limit the relative population density of a particular species. However, in an effort to accelerate the HEP process, the interagency team visited 18 sites and estimated habitat suitability for each evaluation element on a scale of 0 to 10, with 0 being the poorest and 10 being the optimal score. These estimates were based on written summaries of habitat requirements of the species involved and on the professional judgment of the biologists assigning habitat suitability values. This rating is termed the habitat suitability index (HSI). For compatibility with

Table A-1. Comparison of habitat acreages, by target year, under future without project (FWOP), future with Plan 5C (FWP5C), and future with Plan 19C (FWP19C) conditions for the Aloha-Rigolette Area, Louisiana, study.

		Acres by habitat type				
Project condition	Target year	Cleared	Riparian	Altered riparian	Bottomland hardwood	Total
FWOP	1990	24,051	2,913	0	15,027	41,991
FWP5C		24,051	2,913	0	15,027	41,991
FWP19C		24,051	2,913	0	15,027	41,991
FWOP	1994	24,051	2,913	0	15,027	41,991
FWP5C		24,051	2,913	20	15,007	41,991
FWP19C		24,051	2,913	20	15,007	41,991
FWOP	1999	24,051	2,913	0	15,027	41,991
FWP5C		24,681	2,913	20	14,377	41,991
FWP19C		24,051	2,913	20	15,007	41,991
FWOP	2004	24,051	2,913	0	15,027	41,991
FWP5C		25,311	2,913	20	13,740	41,991
FWP19C		24,051	2,913	20	15,007	41,991
FWOP	2019	24,051	2,913	0	15,027	41,991
FWP5C		25,311	2,913	20	13,747	41,991
FWP19C		24,051	2,913	20	15,007	41,991
FWOP	2044	24,051	2,913	0	15,027	41,991
FWP5C		25,311	2,913	20	13,747	41,991
FWP19C		24,051	2,913	20	15,007	41,991

Table A-2. Comparison of habitat acreages by target year, under future without-project (FWOP) and future with Plan 6A (FWP6A) conditions for the Aloha-Rigolette Area, Louisiana, study.

Project Condition	Target Year	Cleared	Riparian	Altered Riparian	Cleared and Snagged Riparian	Bottomland Hardwood	Total
FWOP	1990	24,051	2,913	0	0	15,027	41,991
FWP6A		24,051	2,913	0	0	15,027	41,991
FWOP	1992	24,051	2,913	0	0	15,027	41,991
FWP6A		24,042	2,668	35	245	15,001	41,991
FWOP	1994	24,051	2,913	0	0	15,027	41,991
FWP6A		24,042	2,422	35	491	15,001	41,991
FWOP	1999	24,051	2,913	0	0	15,027	41,991
FWP6A		25,134	2,422	35	491	13,908	41,991
FWOP	2004	24,051	2,193	0	0	15,027	41,991
FWP6A		26,226	2,422	35	491	12,816	41,991
FWOP	2005	24,051	2,913	0	0	15,027	41,991
FWP6A		26,226	2,422	35	491	12,816	41,991
FWOP	2006	24,051	2,913	0	0	15,027	41,991
FWP6A		26,226	2,422	35	491	12,816	41,991
FWOP	2017	24,051	2,913	0	0	15,027	41,991
FWP6A		26,226	2,422	35	491	12,816	41,991
FWOP	2018	24,051	2,913	0	0	15,027	41,991
FWP6A		26,226	2,422	35	491	12,816	41,991
FWOP	2029	24,051	2,913	0	0	15,027	41,991
FWP6A		26,226	2,422	35	491	12,816	41,991
FWOP	2030	24,051	2,913	0	0	15,027	41,991
FWP6A		26,226	2,422	35	491	12,816	41,991
FWOP	2044	24,051	2,913	0	0	15,027	41,991
FWP6A		26,226	2,422	35	491	12,816	41,991

the Service's HEP, these ratings were converted to a scale of 0.00 to 1.00 by simply moving the decimal one digit to the left. Details regarding sample site location, individual sample site scores, and related data are on file in the FWS Lafayette, Louisiana, field office.

The average HSI for each evaluation element over all sample sites within a particular habitat type is termed the mean HSI for that cover type. For each evaluation element, the products of the mean HSI and the habitat acres for each cover type are summed. This sum is divided by the sum of the habitat acres to determine an evaluation species HSI for the project area in a given year. The evaluation species HSI is determined for each target year, from the baseline year to the end of the project life. Target years are established to illustrate significant changes in habitat quality and/or quantity at specific points in time.

The habitat unit (HU) is the basic unit utilized in the HEP for measuring project effects on wildlife. HU's are t product of the evaluation species HSI and the acreage of available habitat at a given target year. Future HU's change according to changes in habitat quality or quantity; these changes are predicted for various target years over the project life, for FWOP and FWP conditions. These values are summed and annualized over the project life to determine the average annual habitat units (AAHU's) available for each species. The change (increase or decrease) in AAHU's under each FWP alternative, compared to FWOP, provides a quantitative comparison of project impacts that are expected to occur with each project alternative. An increase in AAHU's indicates that the project is beneficial to the evaluation species; a decrease in AAHU's indicates that the project is damaging to the evaluation species.

For this project, the target years were selected to indicate project impacts associated with construction, maintenance, and induced clearing under FWOP and various FWP alternatives. The HSI's for each evaluation species, by habitat type, are presented in Table A-3. These HSI's were assumed to remain the same throughout the project life for all habitats except cleared and snagged riparian habitat, which varied with the planned maintenance schedule (once each twelve years) for stream modification features. Habitat acreages at the various target years were multiplied by the appropriate HSI's to calculate HU's for each of the target years. The HU's were then annualized to establish AAHU's for each evaluation species under each future condition (Table A-4).

The AAHU's provide a quantitative measure of habitat conditions under each FWOP and FWP alternative. A comparison of future AAHU's under FWOP and each FWP condition provides a quantitative measure of project impacts (Table A-4). With Plan 5C, white-tailed deer, gray squirrel, and barred owl would receive the greatest adverse impacts. Plan 6A would have the greatest negative impacts on evaluation species. All evaluation species except the mourning dove would be adversely impacted by Plan 6A. Plan 19C is the "action" alternative that would cause the least adverse impacts.

Table A-3. Average habitat suitability index (HSI) values for each evaluation element by habitat type.

Species	Habitat Type		
	Cleared	Riparian[1]	Bottomland hardwood
Mourning dove	0.867	0.569	0.062
White-tailed deer	0.200	0.481	0.862
Gray squirrel	0.058	0.456	0.812
North American mink	0.075	0.694	0.050
Wood duck	0.067	0.475	0.062
Prothonotary warbler	0.067	0.781	0.087
Barred owl	0.158	0.650	0.850

1. Riparian habitat includes baseline and non-impacted riparian habitat only. The HSI's for riparian habitat impacted by the project vary depending on recovery from the proposed project construction and species habitat requirements. HSI's for these habitats are on file in the Fish and Wildlife Service's Ecological Services field office in Lafayette, Louisiana.

Table A-4. Comparison of average annual habitat units (AAHU's) under future without-project (FWOP), future with Plan 5C (FWP5C), future with Plan 6A (FWP6A), and future with Plan 19C (FWP19C) conditions.

	AAHU's						
Species	FWOP	FWP5C	Change due to project[1]	FWP6A	Change due to project[1]	FWP19C	Change due to project[1]
Dove	23,441	24,286	+846	24,729	+1,288	23,441	0
White-tailed deer	19,164	18,453	-711	17,741	-1,423	19,148	-17
Grey squirrel	14,925	14,087	-838	13,446	-1,479	14,909	-16
North American mink	4,577	4,602	+25	4,381	-196	4,575	-1
Wood duck	3,927	3,931	+4	3,719	-208	3,925	-1
Prothonotary warbler	5,194	5,171	-23	4,926	-268	5,192	-2
Barred owl	18,466	17,724	-742	16,901	-1,565	1,845	-15
Total			-1,439		-3,851		-52

1. Change due to the project is calculated by subtracting FWOP AAHU's from future with-project AAHU's prior to rounding to the nearest whole number and, therefore, may not represent the difference between AAHU's as displayed in this table.

ALOHA-RIGOLETTE AREA, LOUISIANA, STUDY

APPENDIX B

MAN-DAY/MONETARY EVALUATION OF FISH AND WILDLIFE RESOURCES

INTRODUCTION

The anticipated monetary impacts of each plan on the fish and wildlife resources of the Aloha-Rigolette Area, Louisiana, study area are provided in this appendix. These impacts include those associated with sport and commercial fish and wildlife harvest and non-consumptive wildlife-oriented recreation. These estimates were developed by determining the carrying capacity and corresponding monetary value of each habitat type on a per-acre basis, and predicting future resource values based on habitat quality and quantity under future without-project (FWOP), future with Plan 5C (FWP5C), future with Plan 6A (FWP6A), and future with Plan 19C (FWP19C) conditions.

FISHERIES

Based on water quality data collected in the project area, published fish population data (Lantz 1970; Williams 1974; Arner et al. 1976; and Tarplee 1972), and conversations with experienced fishery biologists, we estimate that the standing crop of fish in the Bayou Rigolette area is about 250 pounds (lbs)/acre. It was also assumed that about 20 percent (50 lbs/acre) of the standing crop is available game fish, 35 percent (88 lbs/acre) of the standing crop is commercial fish (including catfish), and 40 percent (100 lbs/acre) of the standing crop is shad. The remaining 5 percent of the standing crop was considered to be small game fish, minnows, or other fish of no sport or commercial value.

Studies completed by Tarplee et al. (1972), Congdon (1971), and Arner et al. (1976) provide evidence that channelization of natural streams causes a 68 to 83 percent reduction in the standing crop of fish, a significant reduction in the average size of fish, and a substantial shift to fewer pounds of sport and commercial fish and a relative increase in shad. The proposed stream modification associated with Plan 6A is not as severe as channelization, but involves the near-total removal of in-stream and over-hanging cover that normally provides refuge for fish and shade that reduces water temperatures.

Because fishery resources in the study area have been impacted previously by channel modifications and the proposed action is not as severe as channelization, we concluded that the standing crop would be reduced to 100 lbs/acre with Plan 6A. As a result of the anticipated change in species composition, we assumed that the standing crop of available sport fish would decrease to 5 lbs/acre, commercial fish would decrease to 20 lbs/acre, and the shad population would increase to 60 percent of the total standing crop, but actually decrease in weight to 60 lbs/acre.

According to W.B. Kucera (unpublished manuscript presented at the 1978 Military Area Management Training Session, Southeastern Association of Game and Fish Commissioners, Hot Springs, Virginia), warm-water

fishermen in the United States catch an average of about 1 pound of fish per day. Mr. Kucera acknowledges that fishermen in the southernmost states, where fish production and growth are generally higher, may average as much as 2 pounds per day. Therefore, it was assumed that, because fishery production in the study area is less than optimum, the average catch per man-day of sport fishing to be about 1.5 pounds.

The potential man-days of sport fishing per acre available in the study area were calculated by dividing the lbs/acre of game fish by 1.5 pounds of fish per man-day of fishing. It was assumed that 100 percent of the instantaneous standing crop of available game fish can be harvested annually. The monetary per acre value of sport fishing was calculated by multiplying the man-days per acre by $3.25, i.e., the monetary value of a man-day of general recreation (Table B-1). The man-day and monetary value per acre in the existing stream were estimated to be 33 man-days valued at $107.25 and, in the altered stream, are estimated to be 3.3 man-days valued at $10.83. These values can then be multiplied by the appropriate acreages to determine the total value of the study area to sport fishing under FWOP, FWP5C, FWP6A, and FWP19C.

Project impacts on commercial fisheries were analyzed using a similar methodology. The monetary per-acre value of the fishery was calculated by multiplying the pounds per acre by the appropriate price per pound of fish (Table B-2). These per-acre values were then multiplied by the appropriate habitat acreages to determine the study area's commercial fishery value under FWOP, FWP5C, FWP6A, and FWP19C conditions (Table B-3).

WILDLIFE

Sport

This analysis of sport hunting potential in the area of direct project impact is based on 1) the ability of a given habitat type to support a stable wildlife population and 2) the assumption that a certain portion of the wildlife population can be harvested at a sustainable annual rate without adversely impacting that population. Potential man-day usage and monetary values for game species (excluding waterfowl) shown in Table B-4. A comparison of man-day and monetary values is provided on a per-acre basis by habitat type in table B-5. The impacts of Plan 5C, Plan 6A, and Plan 19C compared to FWOP conditions are displayed in Table B-13 and discussed in the "Summary" section of this appendix.

Estimated waterfowl hunting potential was largely based on average annual acres flooded in each of the habitat types. It was assumed that the waterfowl population density in bottomland hardwood and wooded riparian habitats that are flooded annually is 10 ducks per acre (McCabe et al. 1982), and that forested areas that do not flood annually support only 1 duck per 10 acres. Similarly, it was assumed that cropland and cleared riparian habitat that are flooded annually,

Table B-1. Man-day/monetary value per acre of the sport fishery in the Aloha-Rigolette Area, Louisiana, study area for existing and altered stream conditions.

Habitat type	Pounds sport fish per acre	Pounds per man-day	Man-days per acre	Monetary value per man-day	Monetary value per acre
Existing stream	50	1.5	33.0	$3.25	$107.25
Altered stream	5	1.5	3.3	3.25	10.83

1. The monetary value per man-day of sport fishing was assumed to be the same as the monetary value of a man-day of small game hunting ($3.25) determined by the U.S. Army Corps of Engineers, New Orleans District, Recreation Section.

Table B-2. Monetary value per acre of the commercial fishery in the Aloha-Rigolette Area, Louisiana, study area for existing and altered stream conditions.

Habitat type	Fishery[1]	Pounds commercial fish per acre	Average monetary value per pound	Monetary value per acre
Existing stream	Commercial	88	$0.23	$20.24
	shad	100	0.06	6.00
Altered stream	Commercial	20	0.23	4.60
	shad	60	0.06	3.60

1. Shad are considered a commercial fish; however, because of the difference in monetary value of shad versus other commercial fish, the commercial shad fishery was treated separate from other commercial fish harvest.

2. The average monetary value per pound of commercial fish and shad is based on the average 1978 prices published by the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (1980).

Table B-3. Comparison of potential man-day/monetary values associated with the fishery resource and various future conditions (without project, Plan 5C, Plan 6A, and Plan 19C) in the Aloha-Rigolette Area, Louisiana, study area.

Future condition[1]	Habitat type	Annualized acres	Fishery	Man-days per acre[2]	Monetary value per acre[3]	Man-day value[4]	Monetary value[5]
FWOP	Existing stream	791	sport	33.0	$107.25	26,103	$84,835
			commercial		20.24		16,010
			shad		6.00		4,746
			Total			26,103	105,591
FWP5C/19C	Existing stream	791	sport	33.0	$107.25	26,103	84,835
			commercial		20.24		16,010
			shad		6.00		4,746
	Altered stream	5	sport	3.3	10.83	16	54
			commercial		4.60		23
			shad		3.60		18
			Total			26,119	105,686
FWP6A	Existing stream	508	sport	33.0	$107.25	16,764	$54,483
			commercial		20.24		10,282
			shad		6.00		3,048
	Altered stream	283	sport	3.3	10.83	934	3,035
			commercial		4.60		1,302
			shad		3.60		1,019
			Total			17,698	73,169
Net change							
FWOP vs. FWP5C/19C						+16	+95
FWOP vs. FWP6AC						-8,405	-32,422

Continued

Table B-3 Continued

1. FWOP = future without-project, FWP5C/19C = future with Plan 5C or Plan 19C, FWP6A = future with Plan 6A.

2. Man-days per acre taken from Table B-1.

3. Monetary value per acre is taken from Tables B-1 and B-2.

4. Man-day value is the average annual man-days of fishing in the study area and is the product of the annualized acres and man-days per acre.

5. Monetary value is the average annual monetary value of the fishery in the study area and is the product of the annualized acres and monetary value per acre.

Table B-4. Potential sport hunting (excluding waterfowl) usage in the various habitat types of the Aloha-Rigolette Area, Louisiana, study area.

Habitat type	Species	Population density[1]	Sustainable harvest rate[2]	Success rate[3]	Potential man-days[4]
Riparian	Rabbit	1.000	0.50	0.79	0.395
	Squirrel	1.000	0.50	0.47	0.235
	Raccoon	0.100	0.50	1.00	0.050
	Woodcock	0.100	0.20	1.00	0.020
	Quail	0.167	0.60	0.30	0.030
	Dove	0.050	0.50	0.31	0.078
	Deer	0.033	0.33	26.36	0.287
	Turkey	0.013	0.33	21.57	0.093
Altered Riparian	Rabbit	1.000	0.50	0.79	0.395
	Squirrel	Neg.[5]	0.50	0.47	Neg.
	Raccoon	0.040	0.50	1.00	0.020
	Woodcock	0.067	0.20	1.00	0.013
	Quail	0.170	0.60	0.30	0.031
	Dove	0.050	0.50	0.31	0.008
	Deer	0.012	0.33	26.36	0.104
	Turkey	Neg.	0.33	21.57	Neg.
Cleared	Rabbit	0.067	0.50	0.79	0.026
	Squirrel	Neg	0.50	0.47	Neg.
	Raccoon	Neg	0.50	1.00	Neg.
	Woodcock	0.067	0.20	1.00	0.013
	Quail	0.170	0.60	0.30	0.031
	Dove	1.000	0.50	0.31	0.155
	Deer	0.010	0.33	26.36	0.087
	Turkey	Neg	0.33	21.57	Neg.

Continued

Table B-4 Continued

Habitat type	Species	Population density[1]	Sustainable harvest rate[2]	Success rate[3]	Potential man-days[4]
Bottomland	Rabbit	0.750	0.50	0.79	0.296
	Squirrel	1.333	0.50	0.47	0.313
	Raccoon	0.100	0.50	1.00	0.050
	Woodcock	0.100	0.20	1.00	0.020
	Quail	Neg.	0.60	0.30	Neg.
	Dove	Neg.	0.50	0.31	Neg.
	Deer	0.067	0.33	26.36	0.583
	Turkey	0.013	0.33	21.57	0.093

1. Population density estimates are calculated on a per acre basis and are based on U.S. Army Corps of Engineers (1977), U.S. Department of Agriculture (1979), and best professional judgment.

2. Sustainable harvest is that portion of the population that can be harvested on an average annual basis without adversely affecting that population. These values are commonly accepted among wildlife biologists.

3. The success rate is the man-days of effort per animal harvested and are based on hunter surveys conducted by the Louisiana Department of Wildlife and Fisheries (1978, 1980a, 1980b, 1981), and (undated).

4. Potential man-days is expressed on a per acre basis and is the product of population density, sustainable harvest rate, and success rate.

5. Neg. = negligible.

Table B-5. Potential monetary value per acre of sport hunting in the Aloha-Rigolette Area, Louisiana, study area.

Habitat type	Hunting activity	Potential man-days per acre[1]	Monetary value per man-day[2]	Monetary value per acre[3]
Riparian	Small game[4]	0.808	$3.25	$2.63
	Big game[5]	0.381	12.15	4.62
Altered riparian	Small game	0.467	3.25	1.52
	Big game	0.104	12.15	1.26
Cleared	Small game	0.225	3.25	0.73
	Big game	0.087	12.15	0.91
Bottomland hardwood	Small game	0.697	3.25	2.21
	Big game	0.676	12.15	8.21

1. Potential man-days are summed and taken from Table B-4.

2. Monetary value per man-day was provided by the New Orleans District, U.S. Army Corps of Engineers (unofficial transfer of information on August 31, 1983).

3. Monetary value per acre is the product of potential man-days per acre and monetary value per man-day.

4. Small game hunting includes rabbit, squirrel, raccoon, woodcock, quail, and dove hunting.

5. Big game hunting includes deer and turkey hunting.

support 4 ducks per acre, and that waterfowl usage of non-flooded cropland is negligible. It was also assumed that open water habitat in the study area supports 1 duck per 5 acres, and that altered open water will support negligible duck numbers.

The Corps used stage elevation data recorded from 1957 to 1981 and stage area curves to establish the average number of days of out-of-bank flooding and the average acreage of flooded land by habitat type, during the waterfowl wintering season (November 1 to March 1). Because the average number of days that area streams were out-of-bank was different in the Bayou DuGrappe (Colfax) area compared to the Bayou Rigolette area, each area was reported separately (Table B-6). For each area, the percent of time the streams were out-of-bank during the waterfowl wintering period was multiplied by the average number of acres flooded to obtain an estimate of the average number of acres flooded daily throughout the hunting season (November 1 to January 20; Table B-6). A basic assumption used in this calculation was that the average number of acres flooded during November 1 to January 20 was essentially the same as that for the period November 1 to March 1.

The average acreage flooded on a daily basis during the waterfowl wintering period was necessary to estimate the potential man-day usage of the waterfowl resource in the study area. It was estimated that an average of 357 acres of cleared land and 628 acres of forested land would be flooded daily throughout the waterfowl season under FWOP conditions. With project implementation, a reduction in the average annual acres flooded was predicted for FWP5C/19C and FWP6A. The potential annual man-day use per acre was calculated (Table B-7). These values and other average annual habitat acreages were used to compare potential man-day and monetary values associated with future habitat conditions (Table B-8).

Commercial

Furbearer harvest in the non-coastal areas of Louisiana is much lower than populations can tolerate. Common furbearers trapped for commercial purposes in the study area include raccoon, nutria, muskrat, opossum, mink, otter, fox, bobcat, and coyote. The average annual monetary value of the fur harvest is based on the U.S. Army Corps of Engineers (1977), updated using 1977-78 to 1981-82 prices provided by the Louisiana Department of Wildlife and Fisheries.

Wildlife-oriented Recreation

Participation and monetary values of non-consumptive wildlife-oriented recreation (WOR) were also considered. Participation in WOR was estimated by multiplying the average man-day per acre value by the appropriate habitat acreage (Tables B-9, B-10, B-11, and B-12).

Table B-6. Average acreage flooded daily throughout the waterfowl wintering period under future without-project condition (FWOP) future with Plan 5C and 19C (FWP 5C/19C), and future with Plan 6A (FWP6A) for the Aloha-Rigolette Area, Louisiana, study area.

Project condition	Habitat type	Average acres flooded during waterfowl wintering period (Nov. 1-Mar. 1)	Average annual days flooding during waterfowl wintering period	Percent of waterfowl wintering period during which flooding occurs[1] (Nov. 1-Mar. 1)	Average acreage flooded daily[2]
FWOP	Bayou DuGrappe				
	cleared	2,067	11	9.2	190.2
	forested	849	11	9.2	78.1
	Bayou Rigolette				
	cleared	1,000	18	16.7	167
	forested	3,294	18	16.7	550.1
FWP 5C/19C	Bayou Dugrappe				
	cleared	1,850	11	9.2	170.2
	forested	832	11	9.2	76.5
	Bayou Rigolette				
	cleared	0	18	16.7	0
	forested	2,194	18	16.7	366.4
FWP 6A	Bayou Dugrappe				
	cleared	0	11	9.2	0
	forested	0	11	9.2	0
	Bayou Rigolette				
	cleared	0	18	16.7	0
	forested	1,794	18	16.7	299.6

1. Percent of waterfowl wintering period during which flooding occurs is calculated by dividing the average days flooded during the waterfowl period by 120, i.e., the total number of days of flooding during the winter period.

2. The average acreage flooded daily is the product of the average annual acres flooded and the percent of waterfowl wintering period during which flooding occurs.

Table B-7. Potential waterfowl hunting on a per-acre basis in various habitat types of the Aloha-Rigolette Area, Louisiana, study area.

Habitat type	Population density[1]	Sustainable harvest rate[2]	Success rate[3]	Potential man-days[4]
Flooded				
cleared	4.0	0.4	0.625	0.100
forested	10.0	0.4	0.625	0.250
Non-flooded				
forested	0.1	0.4	0.625	0.002
Open water	0.2	0.4	0.625	0.050

1. Population density estimates are based on U.S. Army Corps of Engineers (1977), McCabe et al. (1982), and best professional judgment.

2. Sustainable harvest rate is that portion of the population that can be harvestedon an average annual basis without adversely affecting that population. This value is taken from U.S. Army Corps of Engineers (1977).

3. Success rate is based on data reported by the Louisiana Department of Wildlife and Fisheries (1980b) for the inland west zone, which includes the study area.

4. Represents potential man-days per-acre; this value is product of population density, sustainable harvest rate, and success rate.

Table B-8. Comparison of man-day/monetary values for waterfowl hunting under future without-project (FWOP), future with Plan 5C (FWP5C), future with Plan 6A (FWP6A), and future with Plan 19C (FWP19C) conditions for the, Aloha-Rigolette Area, Louisiana, study area.

Project condition	Habitat type	Average acreage flooded daily during waterfowl wintering season[1]	Potential man-days per acre[2]	Total man-days[3]	Total Monetary value[4] $
FWOP	Cleared flooded	357	0.100	35.70	460.53
	Forested				
	flooded	628	0.250	157.00	2,025.30
	non-flooded[5]	15,326	0.002	30.65	395.39
	Open water existing	857	0.050	42.85	552.76
	Total			266.20	3,433.97
FWP5C	Cleared flooded	177	0.100	17.70	228.33
	Forested				
	flooded	450	0.250	112.50	1,451.25
	non-flooded	13,845	0.002	27.70	357.68
	Open water existing	857	0.050	42.85	552.76
	Total			200.70	2,589.68
FWP6A	Cleared Flooded	13	0.100	1.30	16.77
	Forested				
	flooded	354	0.250	88.50	1,141.65
	non-flooded	14,764	0.002	29.53	380.94

Continued

Table B-8 Continued

Project condition	Habitat type	Annualized acres[1]	Potential man-days per acre[2]	Total man-days[3]	Total monetary value[4] $
	Open water existing	586	0.050	29.30	377.97
	Total			148.63	1917.33
FWP19C	Cleared flooded	357	0.100	35.70	460.53
	Forested flooded	628	0.250	157.00	2,025.30
	non-flooded	15,564	0.002	31.13	401.58
	Open water existing	857	0.050	42.85	552.77
	Totals			266.68	3,440.17

1. Changes in acres is a result of project-induced reduced water levels and land clearing. Values taken from Table B-6.

2. Potential man-days per acre is from Table B-7.

3. Total man-days is the product of annualized acres and potential man-days per acre.

4. Total monetary value is the product of total man-days and $12.90, which is the monetary value of man-day of duck hunting, as provided by the U.S. Army Corps of Engineers (unofficial transfer of information on August 3, 1983).

5. Includes only non-flooded forested lands.

Table B-9. Man-day/monetary values of the wildlife resources under future without-project (FWOP) conditions.

Project condition	Habitat type	Annualized acres[1]	Activity	Man-days per acre[2]	Monetary value per acre ($)[2]	Man-day value[3]	Monetary value ($)[4]
FWOP	Riparian	2,913	Small-game hunting	0.808	$2.63	2,354	$7,661
			Big-game hunting	0.381	4.62	1,110	13,458
			Trapping		1.02		2,971
			WOR[5]	0.500	1.62	1,457	4,719
	Open water	857	Waterfowl hunting	0.050	0.64	43	548
	Cleared	24,051	Small-game hunting	0.225	0.73	5,411	17,557
			Big-game hunting	0.087	0.91	2,092	21,886
			Waterfowl hunting[6]			36	461
	Bottomland hardwood	15,027	Small-game hunting	0.679	2.21	10,203	33,210
			Big-game hunting	0.676	8.21	10,158	123,372
			Waterfowl hunting			188	2,425
			Trapping		1.02		15,327
			WOR	0.500	1.62	7,514	24,344
					Total	40,566	267,939

1. Annualized acres includes only those acreages having significant value to fish and wildlife resources.
2. Man-day and monetary values per acre are taken from Tables B-5 and B-8.
3. Man-day value is the potential average annual man-days of activity in the study area and is the product of the annualized acres and man-days per acre.
4. Monetary value is the average annual monetary value of the specific activity(ies) in the study area and is the product of the annualized acres and monetary value per acre.
5. WOR = Wildlife-oriented recreation.
6. Annualized acres, man-days per acre, and monetary values per acre for waterfowl hunting in cleared and bottomland hardwood habitat types are taken from Table B-8.

Table B-10. Man-day monetary values of wildlife resources under future with Plan 5C (FWP5C) conditions.

Project condition	Habitat type	Annualized acres[1]	Activity	Man-days per acre[2]	Monetary value per acre ($)[2]	Man-day value[3]	Monetary value ($)[4]
FWP5C	Riparian	2,913	Small-game hunting	0.808	2.63	2,354	7,661
			Big-game hunting	0.381	4.62	1,110	13,458
			Trapping		1.02		2,971
			WOR[5]	0.500	1.62	1,456	4,719
	Altered riparian	20	Small-game hunting	0.467	1.52	9	30
			Big-game hunting	0.104	1.26	2	25
	Open water	857	Waterfowl hunting	.050	.64	43	548
	Cleared	25,101	Small-game hunting	0.225	0.73	5,627	18,323
			Big-game hunting	0.087	0.91	2,176	22,842
			Waterfowl hunting[6]			18	228
	Bottomland hardwood	13,957	Small-game hunting	0.679	2.21	9,477	30,846
			Big-game hunting	0.676	8.21	9,435	114,586
			Waterfowl hunting			140	1,808
			Trapping		1.02		14,237
			WOR	0.500	1.62	6,979	22,611
					Total	38,826	254,893

1. Annualized acres includes only those acreages having significant value to fish and wildlife resources.
2. Man-day and monetary values per acre are taken from Tables B-5 and B-8.
3. Man-day value is the potential average annual man-days of activity in the study area and is the product of the annualized acres and man-days per acre.
4. Monetary value is the average annual monetary value of the specific activity(ies) in the study area and is the product of the annualized acres and monetary value per acre.
5. WOR = Wildlife-oriented recreation.
6. Annualized acres, man-days per acre, and monetary values per acre for waterfowl hunting in cleared and bottomland hardwood habitat types are taken from Table B-8.

Table B-11. Man-day/monetary values of the wildlife resources under future with Plan 6A (FWP6A) conditions.

Project condition	Habitat type	Annualized acres[1]	Activity	Man-days per acre[2]	Monetary value per acre ($)[2]	Man-day value[3]	Monetary value ($)[4]
FWP6A	Riparian	2,461	Small-game hunting	0.808	2.63	1,988	6,472
			Big-game hunting	0.381	4.62	938	11,370
			Trapping		1.02		2,510
			WOR	0.500	1.62	1,230	3,987
	Altered riparian	35	Small-game hunting	0.467	1.52	16	53
			Big-game hunting	0.104	1.26	4	44
	Open water	596	Waterfowl hunting	.050	.64	30	370
	Cleared	25,701	Small-game hunting	0.225	0.73	5,783	18,762
			Big-game hunting	0.087	0.91	2,236	23,388
			Waterfowl hunting[6]			1	17
	Bottomland hardwood	13,343	Small-game hunting	0.679	2.21	9,060	29,488
			Big-game hunting	0.676	8.21	9,020	109,546
			Waterfowl hunting			118	1,524
			Trapping		1.02		13,610
			WOR	0.500	1.62	6,672	21,616
					Total	37,096	242,757

1. Annualized acres includes only those acreages having significant value to fish and wildlife resources.
2. Man-day and monetary values per acre are taken from Tables B-5 and B-8.
3. Man-day value is the potential average annual man-days of activity in the study area and is the product of the annualized acres and man-days per acre.
4. Monetary value is the average annual monetary value of the specific activity(ies) in the study area and is the product of the annualized acres and monetary value per acre.
5. WOR = Wildlife-oriented recreation.
6. Annualized acres, man-days per acre, and monetary values per acre for waterfowl hunting in cleared and bottomland hardwood habitat types are taken from Table B-8.

Table B-12. Man-day/monetary values of the wildlife resources under future with Plan 19C (FWP19C) conditions

Project condition	Habitat type	Annualized acres[1]	Activity	Man-days per acre[2]	Monetary value per acre ($)[2]	Man-day value[3]	Monetary value ($)[4]
FWP19C	Riparian	2,913	Small-game hunting	0.808	2.63	2,354	7,661
			Big-game hunting	0.381	4.62	1,110	13,458
			Trapping		1.02		2,971
			WOR[5]	0.500	1.62	1,456	4,719
	Altered riparian	20	Small-game hunting	0.467	1.52	9	30
			Big-game hunting	0.104	1.26	2	25
	Open water	857	Waterfowl hunting	.050	.64	43	553
	Cleared	24,051	Small-game hunting	0.225	0.73	5,411	17,557
			Big-game hunting	0.087	0.91	2,097	21,886
			Waterfowl hunting[6]			36	461
	Bottomland hardwood	15,007	Small-game hunting	0.679	2.21	10,190	33,165
			Big-game hunting	0.676	8.21	10,145	123,207
			Waterfowl hunting			188	2,426
			Trapping		1.02		15,307
			WOR	0.500	1.62	7,504	24,312
Totals						40,545	267,738

1. Annualized acres includes only those acreages having significant value to fish and wildlife resources.
2. Man-day and monetary values per acre are taken from Tables B-5 and B-8.
3. Man-day value is the potential average annual man-days of activity in the study area and is the product of the annualized acres and man-days per acre.
4. Monetary value is the average annual monetary value of the specific activity(ies) in the study area and is the product of the annualized acres and monetary value per acre.
5. WOR = Wildlife-oriented recreation.
6. Annualized acres, man-days per acre, and monetary values per acre for waterfowl hunting in cleared and bottomland hardwood habitat types are taken from Table B-8.

Table B-13. Comparison of man-day/monetary values by activity under future without-project (FWOP), future with Plan 5C (FWP5C), future with Plan 6A (FWP6A), and future with Plan 19C (FWP19C) conditions.

Project condition	Activity	Total man-days[1]	Total monetary value ($)[1]
FWOP	Fishing	26,103	105,591
	Hunting/trapping/WOR[2]	40,566	267,939
	Totals	66,669	373,530
FWP5C	Fishing	26,119	105,686
	Hunting/trapping/WOR	38,826	254,893
	Totals	64,945	360,579
FWP6A	Fishing	17,698	73,169
	Hunting/trapping/WOR	37,096	242,757
	Totals	54,794	315,926
FWP19C	Fishing	26,119	105,686
	Hunting/trapping/WOR	40,545	267,738
	Totals	66,664	373,424
Net change			
FWOP vs FWP5C		-1,724	-12,951
FWOP vs FWP6A		-11,875	-57,604
FWOP vs FWP19C		-5	-106

1. Total man-days and total monetary value are from Tables B-3, B-9, B-10, B-11, and B-12.

2. WOR = Wildlife-oriented recreation.

SUMMARY

Plan 5C and Plan 6A, are expected to significantly reduce the potential man-day usage and monetary value of the fish and wildlife resources in the study area (Table B-13). Plan 5C would reduce the average annual use of fish and wildlife resources in the study area by 1,724 man-days, and the total value by $12,951. Plan 6A would have greater impacts on these resources by reducing the annual use by 11,875 man-days, and the total value of sport and commercial fish and wildlife resources by over $57,604. Implementation of Plan 19C will decrease the average annual usage by 5 man-days and the total monetary value by $106.

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APPENDIX C

ENGINEERING INVESTIGATIONS

ALOHA-RIGOLETTE AREA, LOUISIANA

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ALOHA RIGOLETTE AREA STUDY

APPENDIX C

ENGINEERING INVESTIGATIONS

C.0.1. The results of engineering investigations presented in this appendix are based on detailed topographic surveys of major bayous, review of existing and historical hydrologic data, hydraulic models, and design and cost studies. The hydrologic and hydraulic studies were conducted in several stages. The performance of each alternative plan was evaluated at the end of each stage to determine the most feasible plan.

SECTION 1. HYDROLOGY

GENERAL

C.1.1. The Aloha-Rigolette drainage basin, approximately 418 square miles, lies on the left bank of the Red River between river miles 108 and 126 in Grant, Rapides, and Winn Parishes, Louisiana. About 80 percent of the basin is wooded hill land; the remainder is comparatively flat alluvial plains. Ground elevations vary from about 70 feet[1/] at the top of bank near the Bayou Rigolette floodgate site to approximately 250 feet in the hill areas. The basin is protected from Red River backwaters by a levee along the Red River left descending bank and a floodgate at the mouth of Bayou Rigolette. The flat alluvial plains are heavily agriculture oriented and soybeans is the principal crop. Mining and timber activities predominate in the wooded hill lands.

C.1.2. The drainage basin is naturally divided into two distinct drainage areas that are separated by Louisiana State Highways 8 and 123. The basin above these highways embraces about 242 square miles and is mostly wooded hill land. The runoff from this area is regulated by Iatt Lake, which is formed by flows from several creeks and bayous. The basin below these highways is about equally divided between hill and bottom lands. The drainage basin empties into the Red River through the Bayou Rigolette floodgate structure just above Pineville.

CLIMATOLOGY

C.1.3. The Aloha-Rigolette area is characterized by mild temperatures and abundant rainfall. The summers are usually long with relatively high

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[1/]All elevations in this report refer to the National Geodetic Vertical Datum (NGVD).

temperatures accompanied by southerly prevailing winds from the Gulf of Mexico. During the short winters, minimum temperatures occur when the winds are from the north and northwest. The heavy precipitation in the study area results from climatic actions of tropical storms moving northward over the area, intensive convective storms from the Gulf of Mexico, and frontal storms resulting from action between moist maritime and cold polar air masses.

TEMPERATURES

C.1.4. Records of temperatures are available from climatological data published by the National Climatic Center, National Oceanic and Atmospheric Administration (NOAA). The Aloha-Rigolette area can be described by using the temperature data observed at Alexandria, Louisiana. The annual normal temperature, based on the period 1951-1980, is 66.5°F and monthly normal temperatures vary from 82.5°F in July to 48.4°F in January. Temperature extremes recorded at Alexandria's Esler Field Station over the normal period were a maximum of 104°F in August 1962 and in August 1980 and a minimum of 5°F in January 1962. The average winter and summer temperatures are 50.3°F and 81.6°F, respectively. The normal monthly temperatures (1951-1980) for Alexandria are as follows:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
48.4	51.6	58.8	67.1	73.9	80.1	82.5	82.1	77.4	67.2	57.5	50.9

C.1.5. The average growing season for the area ranges from 236 to 250 days. The first freezing temperature occurs during the second week of November and the last freezing temperature during the third week of March. In any single year, freezing temperatures can occur on fewer than 20 days or on more than 60 days. Freezing temperatures occur each winter and sixty percent of the winter seasons have temperatures below 20°F.

PRECIPITATION

C.1.6. There are several climatological stations with various periods of record located adjacent to the study area. The station at Alexandria, Louisiana, has a sufficient period of record to accurately represent the normal precipitation over the critical study area: the lower portion of the basin. The annual normal precipitation based on the National Climatic Center records for the period 1951-1980 at Alexandria is 55.9 inches. The maximum monthly rainfall total for the period of record, 36.91 inches, occurred in June 1886. The greatest 24-hour rainfall occurred June 15-16, 1866, and measured 21.4 inches. The heaviest rainfall usually occurs from December to May. December is the wettest month with a monthly normal of 6.30 inches. This is also the period during which high stages on the Red River usually occur. The driest month for the normal period is August with a monthly normal of 3.68 inches. Snow is rare in the study area, and averaging less than 1 inch per year. Many years pass with no measurable snow. Table C-1-1 shows the total monthly and annual precipitation at Alexandria for the period between 1951-1980. The study area precipitation normals are also listed in Table C-1-1.

RUNOFF AND STREAM DATA

C.1.7. There are two major streamflow gaging stations in the basin, both on Bayou Rigolette. One is near Colfax and the other is approximately 3 miles upstream from the mouth of Bayou Rigolette (designated as the Pinevelle gage). Pertinent data such as period of record and the maximum and minimum recorded stages and discharges for these two stations are summarized in Table C-1-2.

C.1.8. The 10 highest 1-day recorded rainfalls in Alexandria since 1950 are shown in descending order of magnitude in Table C-1-3.

TABLE C-1-1

MONTHLY AND ANNUAL PRECIPITATION (1951-1980)
(inches)

Alexandria, Louisiana

Year of Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1951	8.00	2.90	5.83	4.31	3.46	6.38	4.72	1.71	4.50	1.05	0.94	8.00	54.80
1952	2.85	6.46	3.66	7.06	8.03	0.79	6.48	0.52	0.70	-	6.97	5.72	42.86
1953	1.76	7.01	6.59	10.43	16.90	2.47	4.24	2.20	0.34	3.50	2.53	7.06	65.03
1954	4.52	1.18	1.98	5.30	8.05	0.51	4.19	0.10	1.62	4.65	1.68	2.91	36.69
1955	5.66	7.50	0.55	5.55	7.38	3.63	7.05	6.99	0.71	6.14	2.30	3.75	57.21
1956	3.07	9.45	5.30	1.65	2.80	2.55	4.49	1.57	0.55	2.27	3.41	9.34	46.45
1957	1.64	3.92	10.59	5.91	3.19	9.08	4.96	0.29	5.38	9.00	13.62	5.49	73.09
1958	3.09	2.19	4.75	6.30	1.80	4.44	3.22	7.41	10.28	1.25	4.35	1.76	50.84
1959	4.31	5.52	3.76	5.37	3.05	3.89	5.27	2.50	2.38	4.79	1.09	5.85	47.78
1960	6.72	4.15	3.92	2.25	4.94	4.66	4.08	7.29	3.41	5.25	1.58	6.98	55.23
1961	8.69	7.67	12.87	1.96	6.16	8.85	6.26	6.45	2.93	1.87	7.45	8.11	79.27
1962	5.37	2.85	1.81	5.35	2.87	7.84	0.42	4.13	3.58	2.26	4.17	4.52	45.17
1963	3.84	2.91	1.21	0.84	4.41	1.63	8.25	1.36	3.55	0.00	4.20	3.96	36.16
1964	5.33	2.65	6.44	7.79	3.03	2.18	4.10	6.08	5.26	0.73	8.18	7.59	59.36
1965	2.81	6.06	7.28	0.43	1.94	3.00	2.36	4.45	8.38	0.25	4.39	8.06	49.41
1966	7.67	8.33	0.51	8.07	3.20	1.66	2.46	4.43	3.80	4.51	3.94	6.23	54.51
1967	2.05	4.34	2.03	10.81	8.37	2.69	6.95	3.19	2.20	5.59	0.18	14.28	62.68
1968	8.10	3.22	4.02	6.05	4.15	3.00	3.17	5.61	3.61	0.48	6.88	7.17	55.46
1969	1.01	5.96	5.89	4.13	5.79	1.97	13.32	0.30	1.56	3.45	1.97	7.69	53.04
1970	2.08	2.71	3.45	2.40	4.97	5.35	2.62	4.21	3.79	10.36	2.94	2.86	47.74
1971	2.02	5.39	4.39	1.55	7.79	3.65	4.59	2.36	6.14	1.54	2.47	13.98	55.87
1972	9.32	2.04	5.26	1.54	3.97	3.81	4.22	0.37	6.44	10.03	3.52	9.78	60.30
1973	5.51	5.63	13.20	7.64	6.61	4.39	2.80	4.26	7.98	5.17	4.51	4.92	72.62
1974	12.03	3.59	3.30	5.18	5.19	3.74	3.11	4.34	4.55	1.23	4.79	7.92	58.97
1975	3.74	4.06	6.10	5.53	10.03	3.63	6.54	5.14	2.15	6.84	2.98	2.97	59.71
1976	2.13	3.10	8.13	0.74	6.92	10.04	10.50	1.29	3.50	2.24	4.48	5.51	58.58
1977	5.48	2.10	8.34	5.66	3.55	1.69	1.09	7.58	3.14	3.68	9.65	3.84	55.60
1978	6.31	3.90	1.42	0.51	4.54	4.41	6.14	9.36	1.94	0.53	4.93	4.98	48.97
1979	11.14	8.70	4.16	6.95	2.57	3.15	4.44	3.76	11.88	5.27	6.35	5.92	74.29
1980	6.53	4.44	11.03	8.18	3.70	1.53	3.16	1.03	1.27	8.53	4.49	1.75	55.64
NORMAL	5.08	4.66	5.26	4.85	5.31	3.89	4.84	3.68	3.92	3.75	4.36	6.30	55.90

TABLE C-1-2

STREAM GAGING STATIONS

Station	Period of Record	Record Stages (ft.) (NGVD)				Record Discharges (cfs)			
		Max	Date	Min	Date	Max	Date	Min	Date
B. Rigolette NR. Colfax, LA (State Hwy. 8) Sta. 3720015 Gage Zero is @ NGVD	Dec 1939-Present	95.29	4/16-17/45	Dry	11/1-15/48	3520[c]	4/12/68	0.0	8/31/59[a]
B. Rigolette NR. Pineville, LA (Hwy. 1203 Bridge) Sta. 3780015 Gage Zero is @ NGVD	Intermittent 1946-1947 2/48-Present	88.3[b]	5/53	57.9	10/24-25/53	3740[c]	4/18/67	0.0	5/13/66[a]

(a) Also later dates
(b) High water mark
(c) From intermittent data

TABLE C-1-3

TEN HIGHEST 1-DAY RAINFALLS
(1950-1982)

Alexandria, Louisiana

Rank	Date	Rainfall (inches)
1	29 Apr 1953	8.55
2	22 Oct 1972	8.12
3	26 Dec 1982	7.20
4	10 Dec 1964	6.12
5	18 Oct 1980	6.10
6	15 Dec 1967	6.10
7	12 Apr 1974	6.00
8	6 Dec 1971	5.58
9	4 Mar 1977	5.57
10	12 Oct 1970	5.41

C.1.9. Records after 1949 indicate that major flooding on Bayou Rigolette occurred in February 1950, May 1953, June 1957, May 1958, and December 1982. The largest flood of record occurred in May 1953. A discussion of the floods of 1950, 1953, and 1982 follows.

C.1.10. February 1950 Flood. Intense rainfall over the watershed during February produced this flood. For the period 9-14 February, average rainfall over the watershed was 8.8 inches. During this period Colfax, Louisiana, received 9.9 inches with a maximum 1-day rainfall of 3.8 inches on 13 February. Winnfield, Louisiana, located north of the study area, received 9.2 inches with a maximum 1-day rainfall of 4.3 inches on 13 February. Pollock, located a few miles north of Alexandria-Pineville, received 9.2 inches with a maximum of 4.0 inches on 12 February. Between 15-21 February, there was no measurable rainfall. During the period 12-22 February, the average rainfall over the watershed was 1.7 inches. Maximum rainfall during this period was 2.6 inches at Winnfield and 1.7 inches at Pineville on 22 February. The peak flow on Bayou Rigolette at Pineville resulting from this rainfall was estimated to be in excess of 6,500 cfs at a stage of 83.9 feet on 23-24 February.

C.1.11. April-May 1953 Flood. The storm of 24 April to 19 May produced this flood. Prior to the storm, rainfall over the watershed averaged 0.9 inch during the period 1-23 April. Rainfall during the storm was concentrated in the periods 24 April-4 May and 11-19 May. Total rainfall during the storm was 30.5 inches with maximum rainfalls of 12.8 inches and 11.1 inches occurring at Pollock, Louisiana, on 29 April and 17 May, respectively. Alexandria recorded a 1-day rainfall of 8.6 inches, also on 29 April. Near Colfax, Louisiana, about 25 miles upstream of the Pineville gage, the peak flow was 7,279 cfs at a stage of 92.3 feet on 21 May. At Pineville, the peak flow was estimated to be in excess of 9,000 cfs based on a high water mark of 88.3 feet that occurred between 21-27 May.

C.1.12. December 1982 storm. The storm of 25-27 December caused widespread flooding throughout the study area. Most of the area had been saturated by previous rainfall throughout the month (more than two-thirds of the entire state recorded monthly precipitation amounts of 15 inches or more for December 1982). During this period, the Belah Fire Tower precipitation station, located northeast of the study area, received 15.9 inches with a maximum 1-day rainfall of 11.5 inches on 26 December. Winnfield received a total of 16.99 inches from 25-28 December with 7.73 inches on 26 December. The Gorum Fire Tower precipitation station, located a few miles west of Boyce, received 13.55 inches with a maximum of 8.4 inches on 26 December. Alexandria's rainfall totaled 10.84 inches with 7.20 inches falling on 26 December. A peak stage of 82.6 feet was recorded for Bayou Rigolette near Pineville on 2 January 1983. This corresponds to about a 25-year frequency stage. A detailed report of this storm is in Appendix E, December 1982 Post Flood Investigation.

MAJOR DRAINAGE

C.1.13. The Aloha-Rigolette drainage basin begins approximately 2 miles above the small town of Atlanta, Louisiana, and ends approximately 43 miles downstream, just above Pineville, Louisiana. The north and northeast portions of the basin are forested hill lands that drain into Iatt Lake. This lake was formed by a weir that the State of Louisiana constructed in 1947 for wildlife conservation and recreational purposes. Iatt Lake drains 242 square miles (58 percent of the basin total). Iatt Lake at the weir crest (elevation 83 feet) has a surface area of 11.1 square miles (or 7,100 acres), a volume of 31,000 acre-feet, and an average depth of about 4.5 feet. The dam consists of a 1-mile-long earthfill embankment with an elevation of 97 feet and a 250-foot-long uncontrolled concrete overflow spillway with a crest elevation of 83 feet. Through the concrete spillway, there are two sluices 5 feet wide by 7 feet high with an invert at 71 feet for drawing lake levels below elevation 83 feet. The major tributaries of

Iatt Lake are Iatt Creek, Black Creek, and Dartigo Creek. Bayou Rigolette originates at the concrete overflow spillway.

C.1.14. To the west of the Iatt Lake drainage area, another 33 square miles (8 percent of the basin total) are drained by Bayou Du Grappe and its tributaries. Bayou Du Grappe originates about 1.5 miles above the town of Aloha, Louisiana. This area is mainly alluvial flatlands. Bayou Du Grappe follows a southeasterly course 7 miles to the point where it joins Sugarhouse and Valentine Bayous. From the juncture, Bayou Du Grappe becomes Sugarhouse Bayou and continues for 5.2 miles before discharging into Bayou Rigolette, about 2 miles below Iatt Lake spillway.

C.1.15. South of the Iatt Lake and Bayou Du Grappe drainage areas, Bayou Rigolette and its other tributaries drain the remaining 143 square miles of the basin (34 percent of the basin total). Following a southeasterly course, Bayou Rigolette is the primary channel funneling the basin water 27 miles to Red River. East of Bayou Rigolette are mostly forested hills, west is mostly alluvial flatland. Numerous interconnecting bayous in the flatland serve as drainage canals to transport runoff from the agricultural lands in the area. Major tributaries are Bayous Darrow, Sam, Patassa, Marteau, Sandy, Walden, Caney, and Saline.

C.1.16. Flows enter the Red River from the Aloha-Rigolette basin via the Bayou Rigolette floodgate. The floodgate consists of two 10- by 10-foot concrete culverts, approximately 200 feet in length, a vertical gate-operating tower, a stilling basin on the downstream end of the structure, an intake basin on the upstream end, and the necessary approach and outlet channels. This currently represents the only means of evacuating rainfall from the basin. Table C-1-4 provides further data on the floodgate.

TABLE C-1-4

BAYOU RIGOLETTE FLOODGATE

Dimensions	Feet	Elevations	Feet, NGVD
Culverts (two)		Levee, net grade (design)	99.0
Width, each	10.0	Maximum water surface, riverside	98.0
Height, each	10.0	Maximum water surface, landside (gates open)	86.0
Length, each	200.0	Minimum water surface, riverside concurrent with maximum on landside	70.0
Maximum differential head on riverside	28.0	Minimum water surface landside concurrent with with riverside maximum	70.0
Maximum differential head on landside (gates open)	14.0	Invert, upstream end of culverts	59.0
Intake basin		Invert, downstream end of culverts	57.0
Length	75.0		
Width, flared downstream to upstream	21.5 to 52.0		
Stilling basin			
Length	60.0		
Width, flared outlet to end sill	21.5 to 50.0		

SUBAREAS AND ROUTING REACHES

C.1.17. The drainage basin was divided into 8 subareas and 7 routing reaches (see Plate C-1). The subarea boundaries were determined from 1:24,000 USGS quandrangle maps using natural divides and the contour lines. The eight subareas range in size from 9 to 238 square miles. The channel reaches were all established in relation to Bayou Rigolette and were located where storage-discharge routing was necessary in the HEC-1 model. The subareas are designated A through H. The seven routing reach locations are listed below:

Reach 1 - Bayou Rigolette structure to Caney Bayou
Reach 2 - Caney Bayou to Mocassin Bayou
Reach 3 - Mocassin Bayou to Saline Bayou
Reach 4 - Saline Bayou to upper Walden Bayou
Reach 5 - Upper Walden Bayou to Sam Bayou
Reach 6 - Sam Bayou to Sugarhouse Bayou
Reach 7 - Sugarhouse Bayou to Iatt Lake Dam

SYNTHETIC STORMS

C.1.18. Hypothetical storms with frequencies of occurrence from 1 year to 100 years and durations of 24 hours were developed for use in analyzing the study watershed using data obtained from the U.S. Weather Bureau Technical Paper No. 40, "Rainfall Frequenc, Atlas of the United States," published in 1961. Hourly rainfall values were arranged in a sequence favorable to production of critical runoff. Table C-1-5 shows the hourly rainfall in inches for the 24-hour duration storms.

C.1.19. In addition to the 1-year to 100-year, 24-hour storms, the Standard Project Storm (SPS) was also developed for use in analyzing the study watershed. The SPS represents the most severe flood-producing rainfall depth-area-duration relationship and isohyetal pattern of any

TABLE C-1-5

HOURLY RAINFALL AMOUNTS
(Inches)

Aloha-Rigolette Area

Time hrs	1-yr	3-yr	5-yr	Frequency 10-yr	25-yr	50-yr	100-yr
1	0.04	0.06	0.08	0.09	0.12	0.14	0.14
2	0.04	0.06	0.08	0.09	0.12	0.14	0.14
3	0.04	0.06	0.08	0.09	0.12	0.14	0.14
4	0.04	0.06	0.08	0.09	0.12	0.14	0.14
5	0.04	0.07	0.08	0.09	0.12	0.14	0.14
6	0.05	0.07	0.08	0.10	0.12	0.14	0.14
7	0.05	0.07	0.09	0.10	0.12	0.14	0.14
8	0.05	0.07	0.09	0.10	0.12	0.14	0.15
9	0.05	0.07	0.09	0.10	0.13	0.14	0.15
10	0.09	0.13	0.15	0.10	0.23	0.23	0.29
11	0.09	0.14	0.15	0.18	0.24	0.24	0.29
12	0.10	0.14	0.15	0.18	0.24	0.24	0.30
13	0.17	0.23	0.27	0.32	0.38	0.47	0.50
14	0.17	0.24	0.27	0.32	0.39	0.47	0.50
15	0.35	0.60	0.65	0.85	0.95	1.05	1.15
16	1.90	2.35	2.65	2.95	3.35	3.70	4.00
17	0.25	0.30	0.40	0.45	0.50	0.60	0.70
18	0.16	0.23	0.26	0.31	0.38	0.46	0.50
19	0.09	0.13	0.15	0.17	0.23	0.23	0.29
20	0.09	0.13	0.15	0.17	0.23	0.23	0.29
21	0.09	0.13	0.15	0.17	0.23	0.23	0.29
22	0.05	0.07	0.09	0.10	0.12	0.13	0.14
23	0.05	0.07	0.08	0.10	0.12	0.13	0.14
24	0.05	0.07	0.08	0.10	0.12	0.13	0.14
Total	4.10	5.55	6.40	7.40	8.80	9.80	10.80

storm that is reasonably characteristic of the region in which the drainage basin is located. Engineering Manual (EM) 1110-2-1411, "Standard Project Flood Determinations," was used to determine the generalized rainfall criteria for a 96-hour duration SPS. The 96-hour SPS rainfall totaled 20.0 inches for the Aloha-Rigolette watershed. Incremental hourly rainfall amounts were arranged in a sequence favorable to production of critical runoff in each watershed as recommended in EM 1110-2-1411.

HEC-1 MODEL

C.1.20. The hydrology of the Aloha-Rigolette watershed was simulated using the comprehensive Corps of Engineers Hydrologic Engineering Center program, "Hec-1, Flood Hydrograph Package." The HEC-1 program is capable of performing five major types of flood hydrograph analysis.

C.1.21. Unit hydrographs and loss rate parameters had to be developed for each of the subareas in the watershed. Nine storm events that occurred from 1970 to 1979 (see Table C-1-6) were used to develop the 3-hour unit hydrographs and loss rate parameters. The watershed was divided into two major areas: the area above the Iatt Lake Dam and the area below the Iatt Lake Dam (Bayou Rigolette). The parameters were optimized for the two major areas by constructing Thiessen Polygons for the Alexandria and Winnfield precipitation gages. These polygons resulted in a 100-percent weighting of the Winnfield station for the area above the Iatt Lake Dam. The weightings for the area below the Iatt Lake Dam were 40 percent for the Winnfield gage and 60 percent for the Alexandria gage.

C.1.22. The 3-hour unit hydrograph for the Iatt Lake area was obtained from Plate II-2 in the "Definite Project Report for Aloha-Rigolette Area-Grant and Rapides Parishes, Louisiana," published 30 December 1944 by the USCOE-NOD. However, unit hydrograph parameters TC and R from the HEC-1 optimizations were checked for consistency with the "Definite Project

TABLE C-1-6

STORMS USED TO OPTIMIZE UNIT
HYDROGRAPHS AND LOSS RATE PARAMETERS

Storm	Rainfall (inches)	
	Alexandria	Winnfield 2W
11 Oct 1970	5.43	5.00
1 May 1972	3.24	3.70
11-12 April 1974	5.68	11.00
15 Feb 1975	2.47	5.00
10 June 1975	4.23	12.00
25 Oct 1975	1.26	3.30
19 Jan 1979	4.40	8.50
23 Feb 1979	4.30	4.60
12 Dec 1979	4.50	4.00

Report." The 3-hour unit hydrograph for the Bayou Rigolette area and the loss rate parameters for both areas were obtained using the HEC-1 subroutine OPTIM that optimizes the unit hydrograph and loss rate parameters by successive approximations from observed runoff hydrographs. The nine storms were run using the HEC-1 option OPTIM and the resulting unit hydrograpsh were plotted to determine an average unit hydrograph for the Bayou Rigolette area. Separate unit hydrographs were then computed for each of the seven subareas in the Bayou Rigolette area. Those unit hydrographs were computed based on area proportions and on the individual hydrologic characteristics. The results were adjusted to insure the proper volume under each unit hydrograph. The OPTIM option was also used with the nine storms for both the Iatt Lake area and Bayou Rigolette area to determine the initial and constant loss rate parameters. The results were used to construct rainfall vs. loss rate (initial or constant curves to be used to determine the loss rate parameters for the synthetic storm HEC-1 runs. The individual subareas were then grouped according to hydrologic similarity and the loss rate parameters were adjusted to suit each group. This resulted in the starting initial and constant loss rate parameters for each subarea. These values were later adjusted as the loss rate parameters were used to help calibrate the HEC-1 and HEC-2 models for the Aloha-Rigolette watershed.

C.1.23. The synthetic storms, unit hydrographs, and loss rate parameters along with other watershed data were used with the HEC-1 model to simulate the rainfall/runoff process in the study watershed. Flood routing was performed in the HEC-1 model using the Modified Puls method. The loss rate parameters were adjusted in the HEC-1 model (as were the Manning's n values in the HEC-2 model) to balance the stage-storage-discharge relationships between the HEC-1 and HEC-2 models for the watershed.

SECTION 2. HYDRAULIC STUDY

GENERAL

C.2.1. Hydraulic design studies were performed to reproduce existing water surface profiles for the study watershed. The HEC-2 computer program was used with new topographic cross sections taken at various locations along bayous Rigolette, Darrow, Marteau, Saline, Walden, and Sam. Stage-frequency curves for the Pineville and Colfax gages were used to calibrate the HEC-2 model. Once the HEC-2 model had been calibrated to existing conditions, alternative plan project conditions profiles were developed for a range of frequencies between the 1-year, 24-hour storm and the Standard Project Storm.

STAGE-FREQUENCY CURVES

C.2.2. Existing conditions stage-frequency curves for the Pineville and Colfax gages for the 1955-1978 period were obtained from the Aloha-Rigolette Area Reconnaissance Report. Following the collection of data from the 1979-1981 period, the curves were updated to represent the 1955-1981 period. These curves (shown in Plates C-2 and C-3) were used to calibrate the HEC-2 model. Calibration of the HEC-2 model for the study basin was accomplished using a coincident-frequency analysis method that will be discussed later. As part of this method, stage-duration curves were developed for the Red River at the mouth of Bayou Rigolette with and without the Red River Waterway Project in place. The starting water surface elevations for the HEC-2 model were determined based on the stage-duration curves, on rating curves for the existing Bayou Rigolette floodgates using the orifice flow equation, and on the existing conditions Pineville stage-frequency curve.

CHANNEL SURVEYS

C.2.3. Channel surveys were taken in the Aloha-Rigolette watershed from November 1980 to March 1981. Cross sections were obtained at

representative locations in Bayous Rigolette, Darrow, Marteau, Saline, Walden, and Sam. In general, the cross sections were taken where changes in slope, cross-sectional area, or channel roughness occurred, at the beginning or ending of levees, at obstructions, and at bridges. At every channel cross section, the toe and crown of all levees and spoil banks were established. Overbank elevations were taken for a distance of 500 feet on either side of top of bank. Cross sections and data on bridges included low chord elevations, tops of roads, and lengths and widths of bridges. All cross sections were divided into channel, left overbank, and right overbank segments. Flow encroachments such as levees, large obstacles, or deadwater areas were subtracted by means of HEC-2 program options.

BACKWATER COMPUTATIONS

C.2.4. Backwater computations were performed using the comprehensive Hydrologic Engineering Center computer program "HEC-2, Water Surface Profiles," which is similar to the procedure recommended in EM 1110-2-1409, December 1959, "Backwater Curves in River Channels." The program, in addition to computing normal backwater and supercritical flow profiles, checks for critical depth at each cross section. The effects of bridges, culverts, levees, and dams were determined. Multiple profile runs for the selected frequency storms were performed along the seven routing reaches of Bayou Rigolette. In addition, multiple profile runs were performed for Bayous Darrow, Marteau, Saline, Walden, and Sam.

CALIBRATION RUN

C.2.5. The HEC-2 model for the Bayou Rigolette main channel was callibrated using a coincident-frequency analysis method as outlined in EC 1110-2-247. Stage-duration curves were developed for the Red River at the mouth of Bayou Rigolette for the with and without Red River Waterway Project conditions. Those curves are provided in Plate C-4. Representative tailwater elevation of 64, 70, and 80 feet NGVD were

selected for the coincident-frequency analysis. Tailwater rating curves for the floodgates (which empty into the Red River) were developed for with and without the Red River Waterway Project conditions for these elevations. In addition, a headwater rating curve for the two 10- by 10-foot floodgates was developed using the orifice flow equation. Starting water surface elevations behind the Bayou Rigolette structure were developed for the frequency storms and the tailwater elevations cited previously. Discharges for the HEC-2 model were obtained from the HEC-1 model runs. The coincident-frequency analysis method directly relates the probability of exterior stage occurrences with the frequency of interior stages through the use of the total probability theorem. The results of this analysis provided the starting water surface elevation directly behind the floodgates for a specific range of frequencies. Manning's n values for the channel and overbank areas were adjusted in the HEC-2 model during the calibration to produce backwater profiles representative of existing conditions 5-year elevations at the Pineville and Colfax gages. The 5-year event was used because a project designed to protect against such a storm will generally be the most efficient economically. After the HEC-2 model had been calibrated to represent existing conditions (i.e., without the Red River Waterway Project), the model was adjusted to represent conditions that would exist with the Red River Water Project in place. This involved repeating the coincident-frequency runs using the Red River stage-duration curve with the Red River Waterway Project condition. The resulting stage-frequency curves for Pineville and Colfax represent the base conditions that would exist. These curves were used to evaluate the proposed alternative plans. Plates C-2 and C-3 are the stage-frequency curves for the Pineville and Colfax gages for the with and without Red River Waterway Project conditions.

C.2.6. Manning's n values were used for computing all friction losses. Chow's "Open-Channel Hydraulics" (1959) was used as a guide in selecting preliminary n values in combination with the backwater calibration runs. Manning's n values for the bayous tributary to Bayou Rigolette were chosen based on LANDSAT photographs and field reconnaissance. The range of n values used in this analysis are:

Existing Main Channel	0.045-0.060
Improved Naural Channel	0.035-0.040
Overbanks	0.050-0.120

C.2.7. Shock loss coefficients, to correct for additional energy losses that occur as flow passes through transitions, were established as follows:

Natural Channel	0.1-0.3
Bridge Expansion	0.3-0.6
Bridge Contraction	0.2-0.4

C.2.8. Once the HEC-2 model had been calibrated to represent existing conditions, the resulting stage-frequency curves were prepared for the watershed's two gaging stations. Plates C-2 and C-3 are the stage-frequency curves for the Pineville and Colfax gages.

SECTION 3. INTERMEDIATE HYDROLOGIC & HYDRAULIC ANALYSES

C.3.1. After existing conditions were established for the study area, the alternative plans were analyzed. Of the 21 alternative plans proposed to reduce flood damages in the study area, 8 were eliminated after preliminary assessment and evaluation studies were completed. These results were documented in the 1981 Aloha-Rigolette Area Reconnaissance Report. The intermediate hydrologic and hydraulic analysis of the remaining 13 alternative plans was conducted in an initial and a final phase.

INITIAL PHASE - INTERMEDIATE ANALYSIS RESULTS

C.3.2. The initial phase of the analysis tested the concept from which each alternative was developed to see if the study objective of reducing agricultural flood damages in the basin could be satisfied. Through computer simulation, the flood stage reductions that resulted from the most conservative variation of each alternative (i.e., the biggest culvert possible, the highest dam, the largest pump station, etc.) were determined. A tailwater of 64 feet NGVD was assumed when determining starting water surface elevations behind the floodgates. This low tailwater condition was used in order to determine the maximum possible stage lowerings available under each alternative. The coincident-frequency analysis was conducted on the more promising alternatives. Those alternative plans that satisfied the hydrologic and hydraulic objectives of the study were examined in greater detail while the remaining plans were dropped from further study. In the final phase of the intermediate analysis, specific designs for each remaining alternative plan were studied using the coincident frequency analysis method to determine the flood stage reductions that would be achieved.

C.3.3. <u>Plan 1: Increase Iatt Lake storage capacity by raising the height of the dam and providing for controlled release.</u> The net effect of this alternative would be reduction of Iatt Lake flows to Bayou Rigolette. During a preliminary analysis, all flows from Iatt Lake were removed from

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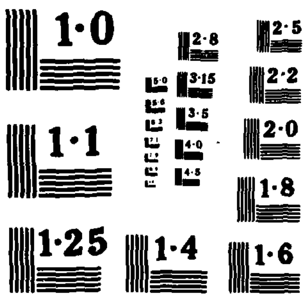
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the HEC-1 model. After computing new flows for the resulting hydrologic model, the HEC-2 model was run to compute the new water surface elevations for the frequency storms studied. The resulting stage-frequency curves (not shown) for the Pineville and Colfax gages indicated that this alternative would not significantly reduce flood stages in the basin. This was attributed to the difference in the timing of peak flows for the Iatt Lake control structure hydrograph and the remaining Bayou Rigolette area hydrographs.

C.3.4. Plan 3: Channel Modification. This plan involved enlargement of all or part of the alluvial area major bayous. Given the scope of the initial phase of the intermediate analysis and the study effort required to determine the locations or degree of channel enlargements, it was decided that analysis of this alternative would be performed during the final phase of the intermediate analysis.

C.3.5. Plan 4: Increase Iatt Lake storage capacity and clear and snag bayous within the alluvial plain. This alternative is the same as Plan 1 with the addition of clearing and snagging the bayous. During a preliminary analysis, all Iatt Lake outflows were removed from the HEC-1 model. The resulting HEC-1 discharges were input into the HEC-2 model where Manning's n values for the channel were reduced from 0.043-0.060 to 0.035-0.040 to simulate the clearing and snagging. The resulting stage-frequency curves (not shown) for the Pineville and Colfax gages indicated that this alternative would not significantly reduce flood stages in the basin.

C.3.6. Plan 5: Provide additional floodgates at the site of the existing Bayou Rigolette floodgates. This plan involved increasing the discharge capacity of the existing Bayou Rigolette floodgates by adding more floodgates. The addition of floodgates to the existing structure would lower the water surface elevation behind the structure. To simulate the greatest possible effects of the additional floodgates, the starting water surface elevations behind the Bayou Rigolette structure were assumed to

equal the Red River water surface elevations plus 1 foot. This allowed for head loss through the structure while providing Bayou Rigolette tailwater stages that approach Red River stages. Then HEC-2 runs were made using the existing conditions HEC-1 outputs to compute the effects on flood levels upstream of the Bayou Rigolette structure. The results of the computer simulations indicate that this plan could significantly lower flood stages within the study.

C.3.7. Plan 6: Reopen the Bayou Darrow closure at Red River and install floodgates. This plan involved separating the study basin into two distinct watersheds. During the initial phase of the intermediate analysis, it was decided that a detailed investigation would be necessary to adequately determine this alternative's effects on flood stages in the study basin. Such an investigation was performed during the final phase of the intermediate analysis.

C.3.8. Plan 8: Clear and snag the alluvial area major bayous and install a pumping station near the existing Bayou Rigolette floodgates. This plan is similar to Plan 5 in that both plans would increase the flow capacity of the Bayou Rigolette structure. However, Plan 8 includes clearing and snagging study area channels. To determine the greatest possible effects of installing a pump station, this plan was modeled in the same manner as Plan 5 where the starting water surface elevations behind the Bayou Rigolette structure were set equal to the Red River stages plus 1 foot in the HEC-2 model. The clearing and snagging of the bayous were simulated in the HEC-2 model by changing the manning's n values for the channel from a range 0.043-0.060 to 0.035-0.040. The results of this simulation indicated that the plan could significantly reduce flood stages in the study basin.

C.3.9. Plan 9: Clear and snag the alluvial area major bayous and install additional floodgates on Bayou Rigolette. This plan is identical to Plan 8 except Plan 9 would use additional floodgates rather than the Plan 8 pumping station at the Bayou Rigolette structure. Because of this similarity, Plan 9 was simulated in the same manner as Plan 8 during the

initial phase of the intermediate analysis. The results of the computer simulations indicated that this plan could significantly lower flood stages in the study area.

C.3.10. Plan 11: Redirect most of the flow from Bayou Rigolette via Sam Bayou to a new channel extending to Red River and install floodgates. The diversion of Bayou Rigolette flow through Sam Bayou represents the diversion of Iatt Lake drainage and the intervening drainage between Iatt Lake and the head of Sam Bayou. The intervening drainage area represents only 8 percent of the total basin and 12 percent of the basin above the head of Sam Bayou. Because of the proximity of Sam Bayou to Iatt Lake, this diversion would affect the lower alluvial plain in much the same way as would controlling Iatt Lake flow. Therefore, the results of Plan 11 were considered the same as for Plan 1. Plan 1 demonstrated that flood stages throughout the basin would not be significantly lowered.

C.3.11. Plan 12: Provide a series of upstream reservoirs in the wooded upland areas of the basin by constructing small, flood-retarding structures. The net effect of this plan, identical to Plan 1, would be the reduction of Iatt Lake flows to Bayou Rigolette. Thus, the analysis performed in Plan 1 and the results are applicable to this plan. Those results showed that stage lowerings would be achieved in the upper basin, but the Pineville gage did not reveal any substantial lowering on Bayou Rigolette.

C.3.12. Plan 18: Clear and snag major bayous in the alluvial plain and acquire in fee or acquire an easement over lands subject to flooding when floodgates must be closed. The clearing and snagging of the bayous was simulated in the HEC-2 model by reducing the Manning's n values for the changes from a range of 0.043-0.060 to 0.035-0.040. Then the HEC-1 and HEC-2 models were run to determine the effects when the floodgates are open. The effects of closing the floodgates during high Red River stages were modeled by first collecting the maximum storages for the combined runoffs from the existing conditions HEC-1 runs for each of the frequency

storms studied. Next, those storages were used to obtain the corresponding stages from the storage-stage curve in the "Definite Project Report for Aloha-Rigolette Area - Grant and Rapides Parishes, Louisiana," published December 1944 by USCOE-NOD. After adjusting those stages slightly to reflect the stage-frequency relationships for the study area, the stages were used as the starting water surface elevation in the HEC-2 runs. The results indicate that this plan would not significantly reduce flood stages when the floodgates are open.

C.3.13. Plan 19: Provide additional floodgates at the site of the existing floodgates (Plan 5) and acquire in fee or acquire an easement over lands subject to flooding when the floodgates must be closed. When the floodgates are left open, the results of Plan 5 are applicable to Plan 19. The results of these simulations indicated that this plan could significantly lower flood stages in the study basin when the floodgates are open. The effects of having the floodgates closed was not assessed during this phase but was assessed during the final phase of the intermediate analysis.

C.3.14. Plan 20: Install a pumping station near the existing floodgates. This plan is similar to Plan 5 in that it would increase the Bayou Riglolette structure's flow capacities. Therefore, Plan 20 was modeled in the same manner as Plan 5 during the initial phase of the intermediate analysis. The results of the computer simulations indicated that this plan could significantly lower flood stages in the basin.

C.3.15. Plan 21: No action. Under this plan, no Federal action would be taken. Flooding would continue to occur in the basin as it would under conditions with the Red River Waterway project in place.

FINAL PHASE - INTERMEDIATE ANALYSIS RESULTS

C.3.16. Following the initial phase of the intermediate analysis, 6 of the proposed 13 alternative plans were eliminated from further study because

they did not meet the study objectives. The remaining seven plans, which included the "No Action Plan" (Plan 21), were selected for further study during the final phase of the intermediate analysis. In addition, three new options of Plan 9 involving various types and combinations of additional floodgates and clearing and snagging were also investigated in this phase along with a "no-structure" alternative (Plan 22). Six action alternatives, Plans 3, 5, 6, 9, and 20, and the new alternatives were analyzed in detail using the coincident-frequency analysis method to determine their effects on flood stages in the basin. The methodology and the results of the final phase of the intermediate analysis are discussed with each plan.

C.3.17. Plan 3: Channel modification. Detailed analysis of this alternative was divided into three parts. Plan 3A involved clearing and snagging Bayous Rigolette, Sugarhouse, DuGrappe, Sam, Saline, Darrow, Walden, and Marteau. The clearing and snagging of the waterways were simulated in the HEC-2 model by changing the Manning's n values for the channel from a range of 0.043-0.060 to a range of 0.035-0.040. Once the Manning's n values were changed, the HEC-1 and HEC-2 models were run for the frequency storms studied. Plan 3B involved channel enlargement of sections of Bayous Rigolette, Darrow, and Saline (including the diversion channels). Sections to be enlarged were chosen based on inspection of overflow patterns, channel cross sections, and the existing channel slopes. Channel inverts were lowered 1 to 2 feet, bottom widths were widened, and side slopes were cut to 1V on 3H. The remaining basin waterways were cleared and snagged as under Plan 3A. The channel improvements were simulated by the HEC-2 model using the CHIMP option. Plan 3C was identical to Plan 3B except that the channel inverts of the enlarged sections were lowered an additional foot and the bottom widths were further widened. This plan was modeled in the same manner as Plan 3B. The resulting stage-frequency curves for the Pineville and Colfax gages for these three options indicated that flood stages within the study area could be significantly reduced by the use of channel improvements. Plate C-5 and C-6 show the resulting stage-frequency curves for each option of Plan 3 at the Pineville and Colfax gages, respectively.

C.3.18. Plan 5: Provide additional floodgates at the site of the existing Bayou Rigolette floodgates. Detailed investigation of this alternative was divided into four parts. Plan 5A involved the addition of two 10- by 10-foot floodgates to the existing two 10- by 10-foot floodgates at the Bayou Rigolette structure. Plan 5B involved the addition of four 10- by 10-foot floodgates to the existing structure. Plan 5C involved the addition of six 10- by 10-foot floodgates to the existing structure. A fourth option, Plan 5D, was later added to determine if the optimum plan had been identified in terms of net excess benefits over cost. This option consisted of adding eight more 10- by 10-foot floodgates adjacent to the existing structure. Stage-discharge curves for each floodgate option were developed using the orifice flow equation. In addition, a tailwater rating curve at the Bayou Rigolette structure (employing the mean annual stage in the Red River at Alexandria with the Red River Waterway Project in place) was used to aid in determining the head loss that would occur through the structure. The HEC-1 routing through the structure was done for each frequency storm studied using storage-discharge relationships developed for each option. The resulting discharges were used with the stage-discharge and tailwater curves to determine the starting water surface elevations for the HEC-2 model. The resulting stage-frequency curves for the Pineville and Colfax gages indicated that increasing the number of floodgates could significantly lower the flood stages in the basin, particularly in the middle and lower reaches. The stage-frequency curves for the Pineville and Colfax gages for each option of Plan 5 are shown in Plates C-7 and C-8, respectively.

C.3.19. Plan 6: This plan provides for opening the Bayou Darrow closure on the Red River and installing floodgates. Implementation of this plan would also require partial or full closures to be made on Bayou Rigolette just below the junction of Bayou Darrow and Bayou Rigolette and on the diversion channel near the mouth of Bayou Darrow. These closures would separate the basin into two watersheds. Detailed investigation of this alternative was divided into four parts. Plan 6A involved installation of

four 10- by 10-foot floodgates, channel enlargement of Bayous Rigolette and Darrow, and clearing and snagging of Bayous Saline and Sam. Plan 6B involved installation of five 10- by 10-foot floodgates, channel enlargement of Bayous Rigolette and Darrow, and clearing and snagging of Bayous Saline and Sam. Plan 6C involved installation of six 10- by 10-foot floodgates and clearing and snagging of each of the four bayous. Plan 6D involved installation of seven 10- by 10-foot floodgates and clearing and snagging of each of the four bayous. In all four options, the flows from Sugarhouse Bayou, Iatt Lake, and Sam Bayou were diverted at Sam Bayou to Bayou Darrow. In each option, a sump area would be created at the mouth of Bayou Darrow. A stage-duration curve for the Red River at the Bayou Darrow mouth was developed for use in the coincident-frequency analysis (Plate C-9). Study of this plan indicated that the existing Bayou Rigolette structure was adequate to handle the remaining flow below the proposed Bayou Darrow diversion. For Plans 6A, 6B, 6C, and 6D, HEC-1 and HEC-2 models were developed, treating Bayou Darrow and Bayou Rigolette as separate watersheds. The models were developed from the existing conditions model for the entire basin. Routing relationships were developed for the Bayou Darrow floodgates from stage-discharge curves based on the orifice flow equation and from tailwater curves developed at the outlet of Bayou Darrow, assuming the Red River Waterway Project to be in place. The results of these plans indicated that flood stages would be significantly reduced on Bayou Rigolette. However, becaue of the diversion of Sugarhouse Bayou, Iatt Lake, and Sam Bayou flows, the reductions on Bayou Darrow are not as great as those on Bayou Rigolette. The resulting stage-frequency curves at the Pineville and Colfax gages on Bayou Rigolette are shown in Plates C-10 and C-11, respectively,.for each option of Plan 6.

C.3.20. Plan 9: Install additional floodgates near the existing floodgates and clear and snag the major basin bayous. This plan is identical to Plan 5 with the additional measure of clearing and snagging. The detailed investigation was divided into several plans. Plan 9A involved adding two 10- by 10-foot floodgates adjacent to the two existing 10- by 10-foot floodgates. Plan 9B involved the addition of four 10- by 10-foot floodgates and Plan 9C involved the addition of six 10- by 10-foot floodgates. A fourth option, Plan 9D, involved adding 8 more 10- by

10-foot floodgates adjacent to the existing structure. All four plans included clearing and snagging all major bayous in the basin. After studies showed that the clearing and snagging of all major channels would not be economically justified, lesser plans involving partial and selective clearing and snagging were analyzed. The four gate configurations of Plans 9A, 9B, 9C, and 9D were hydraulically analyzed for the partial and selective clearing and snagging plans, with detailed economic analysis done for the addition of the four 10- by 10-foot floodgates option. Plans 9B, 9B2, 9B3, and 9B4 were formulated and would consist of four 10-by 10-foot floodgates, plus varying amounts and types of clearing and snagging. Plan 9B1 would include clearing and snagging Bayou Rigolette only. Plan 9B2 would include clearing and snagging of all streams in the alluvial floodplain except Bayou DuGrappe and Sugarhouse Bayou. Plan 9B3 would include clearing and snagging of all major streams in the alluvial floodplain. Plan 9B4 would consist of four 10- by 10-foot floodgates, plus selective clearing and snagging, that is, removal of stream obstructions and overhanging trees along the entire 60 miles of streams listed in Plan 9B3. Since the floodgates of Plan 9 are the same as the floodgates used in Plan 5, the same HEC-1 models used under Plan 5 were used under Plan 9. These models had already been set up to simulate the operation of the floodgates. The clearing annd snagging and the partial clearing and snagging were simulated in the HEC-2 models by reducing the Manning's n values for the channels from a range of 0.043-0.060 to 0.035-0.040. For the selective clearing and snagging, the Manning's n values for the channels were reduced from a range of 0.043-0.060 to 0.040-0.050. The results of these plans indicate that flood stages could be significantly reduced. Plates C-12 through C-19 show the resulting stage-frequency curves at the Pineville and Colfax gages, respectively, for each option of Plan 9.

C.3.21. Plan 19: Provide additional floodgates at the site of the existing floodgates (Plan 5) and acquire in fee or acquire an easement over lands subject to flooding when the floodgates must be closed. Plans 19A, 19B, and 19C involved the addition of two, four, and six 10- by 10-foot

floodgates, respectively, adjacent to the existing two 10- by 10-foot floodgates. These plans are exactly the same as Plans 5A, 5B, and 5C when the floodgates are open. Therefore, the results of Plan 5 are applicable for Plan 19 when the floodgates are open. The effect of closing the Plan 19 floodgates when the Red River stages are high was modeled by collecting the maximum storages for the combined runoffs from the existing conditions HEC-1 runs for each of the frequency storms studies. These storages were then used to obtain the corresponding stages from the stage-storage curve in the "Definite Project Report for Aloha-Rigolette Area - Grant and Rapides Parishes, Louisiana." After adjusting the stages slightly to reflect the stage-frequency relationships for the study area, the stages were used as the starting water surface elevations in the HEC-2 runs along with existing condition flows. The results indicated that this plan could significantly lower flood stages when the floodgates were open. Plates C-20 and C-21 show the resulting stage-frequency curves for each option of Plan 19 at the Pineville and Colfax gages, respectively.

C.3.22. <u>Plan 20</u>: Install a pumping station near the existing floodgates. Detailed investigation of this plan was divided into three parts. Plan 20A involved the installation of a 1,000-cfs-capacity pumping station near the existing Bayou Rigolette floodgates. Plan 20B involved the installation of a 2,000-cfs-capacity pumping station near the existing structure. Plan 20C involved the installation of a 3,000-cfs-capacity pumping station near the existing structure. The pumping station in each plan was simulated in the HEC-1 model by using the diversion option (DI and DO cards). The diversion component was used to simulate the action of typical pumping plant based on realistic pumping rates and experience related to known pump station sizes within NOD. Once the diversion cards had been set up to simulate the pump station operations, the HEC-1 computer runs were made. The flow outputs were used in the HEC-2 model to determine the new water surface profiles for each option. The results indicate that these plans could substantially reduce flood stages in Bayou Rigolette. Plates C-22 and C-23 show the resulting stage-frequency curves at the Pineville and Colfax gages for each option of Plan 20, respectively.

C.3.23. Plan 21 - No Action. Under this plan, no Federal action would betaken. Flooding would continue to occur in the basin as it would under conditions with the Red River Waterway Project in place.

C.3.24. Plan 22 - "No Structure" Alternative. This plan involves removing the Bayou Rigolette floodgates and replacing them with a trapezoidal channel through the Red River Levee with a top width and cross sectional area at least equal to the existing section at the Rigolette floodgates. It is recommended that the new trapezoidal channel have a bottom width of 115 feet, IV on 3H side slopes, and an invert elevation of 52.5 ft. NGVD. Detailed investigation of this alternative was divided into two parts. The first part was a "No Structure" alternative under coincident-frequency conditions on the Red River. The second part was a "No Structure" alternative with the backwater effects of the Red River as the controlling factor. An investigation of the stage-frequency curves in Bayou Rigolette at the Pineville gage indicates that if the Bayou Rigolette structure were removed, the Red River backwater effects would predominate. The stage-frequency curves at the Pineville and Colfax gages are shown in Plates C-24 and C-25, respectively, for the coincident frequency analysis and the Red River backwater effects.

SECTION 4. DESIGN AND COST STUDIES

GENERAL

C.4.1. Design considerations and cost estimates for those alternative plans investigated during the final intermediate phase (Plans 3, 5, 6, 9, 19, and 20) are provided in this section. These plans consist of three management measures: floodgates, pumping stations, and channel improvements.

FLOODGATE DESIGN AND SITE CONSIDERATION

C.4.2. The proposed floodgates were designed to: (a) pass interior drainage without excessive heads when the Red River is not above flood stages, (b) release stored water on a falling river without damage incident to scouring velocities, and (c) empty the sump pool as soon as practicable so that adjoining areas may be made available for agriculture and so that the sump area may be available for further storm runoff. The site and number of proposed floodgates were determined based upon their ability to meet the above criteria. The existing configuration of the Bayou Rigolette structure was also considered while determining the size and number of the proposed floodgates. Flow capacity of the floodgates was based on the orifice flow equation. The inflow and outflow channels for the proposed floodgates were designed to adequately convey the required flows with velocity heads low enough to prevent excessive channel scouring. The proposed floodgates would use vertical lift gates to prevent backwater flooding from Red River. Concrete culverts were chosen for the floodgates because of the longevity and normally low maintenance requirements of the material.

C.4.3. From an engineering perspective, the most efficient location of additional floodgates on Bayou Rigolette is adjacent to the existing structure. Locating the floodgates east rather than west of the existing structure would minimize the total inflow and outflow channel lengths. This distance from the floodgate was governed by the minimum distance that would permit construction and not jeopardize the existing structure's integrity. Care was also taken to avoid relocation of the Kansas City Southern Railway. The proposed Bayou Darrow floodgate structure would be located at the site where Bayou Darrow previously entered the Red River in order to minimize the length of floodgates needed through the levee and to minimize channel excavations needed for the inflow and outflow channels. All slope lines for the excavation and earth sections and the sheet pile cut-off elevations were based on soil and foundation considerations. During construction, a horseshoe-shaped earthen cofferdam would be constructed to the existing Red River levee on the landside and floodside and would be used to protect the construction site.

CHANNEL DESIGN

C.4.4. Channel improvements for the plans were designed to efficiently convey flood flows to either the existing or proposed floodgates and minimize the need for a ponded area. Channel slopes were designed to aid in efficiently conveying the floodflows while avoiding velocities that would excessively scour the channels. Typical cross sections of channel modification and diagrams of disposal configurations are provided in Figures 2 and 3, respectively, in Appendix A, Plan formulation.

PUMPING STATION DESIGN AND SITE CONSIDERATION

C.4.5. The pumping station for Plan 20 was designed for the same purposes as were the floodgates. The number and sizes of pumps were based on the needed pumping capacities, the availability of adequate pumping heads and sump pool elevations, and on professional experience gained from working on other pumping facilities within the New Orleans District. The facility was

designed to provide phased operation in which individual pumps would be used in sequence as the water surface elevation on the protected side increased. Diesel pumps were selected due to the remote location of the site and the expected difficulty and expense of providing large power lines to the site to power electrical pumps. In addition, the expected infrequent use of the pumps tends to make diesel pumps more economical than electrical pumps. Manual controls were expected to be more economical than automated controls due to the infrequent use of the pumping station.

C.4.6. The proposed pumping station was located to the west of the existing floodgates and behind the mainline levee so that an adequate inflow channel to the facility could be provided without relocating a nearby portion of the Kansas City Southern Railway. The location selected also afforded the use of the mainline levee and the railway embankment as part of the construction cofferdam, thereby helping to minimize cost. An illustration of the pumping station is shown as Figure 7, Appendix A, Plan Formulation.

FOUNDATIONS AND MATERIALS

C.4.7. Existing soil data in the vicinity of the floodgate were taken from the "Definite Project Report for Aloha-Rigolette - Grant and Rapides Parishes, Louisiana" dated 30 December 1944 (see Plates C-26, 27, and 28). To supplement that data, five generalized borings scattered through the basin were specifically obtained under this investigation (see Plate C-29). The borings were taken on Bayou Rigolette near the Grant-Rapides Parish line, at the mouth of Bayou Darrow near the Red River levee, midway in Bayou Darrow, between Sam Bayou and the Red River levee, and at the Iatt Lake spillway near the structure.

C.4.8. The alluvial plain of Bayou Rigolette is an area of low relief consisting of Holocene sediments that owe their presence to the shifting course of the Red River. Generally, the top stratum consists of point bar sands 40 to 50 feet thick, natural levee silts and silty sands less than 10

feet thick, and dense backswamp clays up to 50 feet thick. These deposits are over the thick (over 100 feet), course-grained sand and gravel that make up the substratum deposits.

COST ESTIMATES

C.4.9. The detailed cost estimates (excluding mitgation cost) made for each option were based on January 1985 price levels. The estimates are presented in Tables C-4-1 through C-4-20. The only relocation required would be for implementation of Plans 3b and 3c. The facilities to be relocated are bridges and gas pipelines. The real estate estimates include perpetual easements for channels and structures and temporary easements for disposal area and cofferdam construction. A summary of the cost estimates is presented in Table C-4-21.

OPERATION AND MAINTENANCE COST ESTIMATES

C.4.10. Detailed estimates of yearly operation and maintenance costs were made for each plan option based on January 1985 price levels. Annual operation and maintenance (O&M) costs consisted of three elements: channel O&M based on 12 year intervals, floodgate O&M, and pumping station O&M. Channel maintenance costs vary between $33,000 for Plan 6 to $80,000 for Plan 3. Floodgate O&M costs varies depending on the size of the structure between $6,000 and $25,000 annually. Pumping station O&M costs varied with structure size and fuel consumption between $434,000 to $798,000. The annual operation and maintenance costs for the plans analyzed economically are listed on page 103.

TABLE C-4-1

FIRST COST

Plan 3A
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Cropland	137	Ac	$2,000	$274,000
	(2) Cropland	35	Ac	1,400	49,000
	(3) Woodland	175	Ac	500	87,500
	(4) Woodland	113	Ac	300	33,900
	Subtotal	460			$444,400
	b. Temporary Material Disposal Easement (3 yrs.)				
	(1) Cropland	120	Ac	$ 800	$ 96,000
	(2) Cropland	46	Ac	560	25,760
	(3) Woodland	82	Ac	240	19,680
	Subtotal	248			$141,440
	Improvements				0
	Severance Damage				0
	Subtotal	708			$585,840
	Subtotal (R)				$586,000
	Contingencies (±25%)				147,000
	Acquisition Cost	90	tracts	$1,400	126,000
	Total--Lands and Damages				$859,000
	TOTAL NON-FEDERAL COST				$859,000

TABLE C-4-1 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
09.	Channels				
	a. Bayou Rigolette				
	(1) Mobilization & demobilization		L.S.		$ 50,000
	(2) Clear & snag channel	25.74	Mi	$15,000	386,100
	(3) Clear berm & disposal areas	378	Ac	1,200	453,600
	Subtotal				$889,700
	b. Bayou Darrow				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Clear & snag channel	7.64	Mi	$15,000	114,600
	(3) Clear berm & disposal areas	112	Ac	1,200	134,400
	Subtotal				$284,000
	c. Bayou Marteau				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	4.0	Mi	$12,000	48,000
	(3) Clear berm & disposal areas	54	Ac	1,200	64,800
	Subtotal				$137,800
	d. Bayou Sam				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	5.0	Mi	$12,000	60,000
	(3) Clear berm & disposal areas	36	Ac	1,200	43,200
	Subtotal				$128,200
	e. Bayou Saline				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Clear & snag channel	5.5	Mi	$ 8,000	44,000
	(3) Clear berm & disposal areas	39	Ac	1,200	46,800
	Subtotal				$125,800
	f. Bayou DuGrappe & Sugarhouse				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	12.2	Mi	$ 8,000	97,600
	(3) Clear berm & disposal areas	89	Ac	1,200	106,800
	Subtotal				$229,400

TABLE C-4-1 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
09.	Channels (Continued)				
	Subtotal				$1,794,900
	Contingencies (±25%)				448,100
	Total--Channels				$2,243,000
	SUMMARY OF FEDERAL COSTS				
09.	Channels				$2,243,000
30.	Engineering & Design (±19%)1/				428,000
	Engineering & Design--Acquisition				8,000
31.	Supervision & Administration (±8%)				182,000
	TOTAL FEDERAL COST				$2,861,000
	TOTAL PROJECT FIRST COST				$3,720,000

1/ Includes pre-construction planning estimate.

TABLE C-4-2

FIRST COST

Plan 3B
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Cropland	191	Ac	$2,000	$382,000
	(2) Cropland	35	Ac	1,400	49,000
	(3) Woodland	189	Ac	500	94,500
	(4) Woodland	167	Ac	300	50,100
	Subtotal	582			$575,600
	b. Temporary Material Disposal Easement (3yrs)				
	(1) Cropland	147	Ac	$1,500	$220,500
	(2) Cropland	25	Ac	800	20,000
	(3) Cropland	71	Ac	1,050	74,550
	(4) Cropland	15	Ac	560	8,400
	(5) Woodland	143	Ac	400	57,200
	(6) Woodland	1	Ac	240	240
	Subtotal	402			$380,890
	Improvements				0
	Severance Damage				0
	Subtotal	984			$956,490
	Subtotal (R)				$ 956,000
	Contingencies (+25%)				239,000
	Acquisition Cost	120	tracts	$1,400	168,000
	Total--Lands and Damages				$1,363,000
02.	Relocations				
	a. Bridge (Lt. Dty.), B. Rigolette, Mi. 3.2	125	LF	$1,450	$181,300
	b. Bridge (Lt. Dty.), B. Rigolette, Mi. 11.8	100	LF	1,450	145,000

TABLE C-4-2 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
02.	Relocations (Continued)				
	c. Bridge (Lt. Dty.), B. Rigolette, Mi. 15.9	75	LF	$1,450	$ 108,800
	d. Bridge (Med. Dty.), B. Rigolette, Mi. 16.3	75	LF	1,550	116,300
	e. Bridge (Hvy. Dty.), B. Rigolette, Mi. 16.9	75	LF	2,065	154,900
	f. Bridge (Lt. Dty.), B. Darrow, Mi. 3.9	75	LF	1,450	108,800
	g. Bridge (Med. Dty.), B. Darrow, Mi. 6.6	75	LF	1,550	116,300
	h. Bridge, RR, Saline B.--Div. Ch., Mi. 2.1	50	LF	2,065	103,300
	i. Bridge, RR, B. Rigolette, Mi. 0.1	125	LF	2,065	258,200
	j. Gas Pipeline, 8" diameter, B. Rigolette, Mi. 6.5	250	LF	125	31,300
	k. Gas Pipeline, B. Rigolette, Mi. 9.8				
	(1) 26" diameter	225	LF	220	49,500
	(2) 30" diameter	225	LF	290	65,300
	(3) 36" diameter	225	LF	385	86,700
	l. Gas Pipeline, Saline B., Mi. 2.1				
	(1) 26" diameter	200	LF	220	44,000
	(2) 30" diameter	200	LF	290	58,000
	(3) 36" diameter	200	LF	385	77,000
	Subtotal				$1,704,700
	Contingencies (±25%)				426,300
	Total--Relocations				$2,131,000
	SUMMARY OF NON-FEDERAL COSTS				
01.	Lands and Damages				$1,363,000
02.	Relocations				2,131,000
	TOTAL NON-FEDERAL COST				$3,494,000

TABLE C-4-2 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
09.	Channels				
	a. Bayou Rigolette				
	(1) Mobilization & demobilization		L.S.		$ 50,000
	(2) Excavation	1,070,000	CY	$ 1.75	1,872,500
	(3) Clearing	480	Ac	1,200	576,000
	(4) Dress & seed disposal banks	221	Ac	350	77,400
	(5) Clear & snag channel	1.85	Mi	15,000	27,800
	Subtotal				$2,603,700
	b. Bayou Darrow				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Excavation	55,000	CY	$ 2.50	137,500
	(3) Clearing	109	Ac	1,200	130,800
	(4) Dress & seed disposal banks	35	Ac	350	12,300
	(5) Clear & snag channel	1.75	Mi	15,000	26,300
	Subtotal				$341,900
	c. Bayou Marteau				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	4.0	Mi	$12,000	48,000
	(3) Clear berm & disposal areas	54	Ac	1,200	64,800
	Subtotal				$137,800
	d. Bayou Sam				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	5.0	Mi	$12,000	60,000
	(3) Clear berm & disposal areas	36	Ac	1,200	43,200
	Subtotal				$128,200
	e. Bayou Saline				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Excavation	315,000	CY	$ 1.50	472,500
	(3) Clearing	112	Ac	1,200	134,400
	(4) Dress & seed disposal banks	59	Ac	350	20,700
	Subtotal				$662,600

TABLE C-4-2 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
09.	Channels (Continued)				
	f. Bayou DuGrappe & Sugarhouse				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Excavation	131,000	CY	$ 2.50	327,500
	(3) Clearing	89	Ac	1,200	106,800
	(4) Dress & seed disposal banks	45	Ac	350	15,800
	(5) Clear & snag channel	12.2	Mi	8,000	97,600
	Subtotal				$572,700
	Subtotal				$4,446,900
	Contingencies (±25%)				1,111,100
	Total--Channels				$5,558,000
	SUMMARY OF FEDERAL COSTS				
09.	Channels				$5,558,000
30.	Engineering & Design (±14%)1/				776,000
	Engineering & Design--Acquisition				9,000
31.	Supervision & Administration (±8%)				443,000
	TOTAL FEDERAL COST				$6,786,000
	TOTAL PROJECT FIRST COST				$10,280,000

1/ Includes pre-construction planning estimate.

TABLE C-4-3

FIRST COST

Plan 3C
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Cropland	191	Ac	$2,000	$382,000
	(2) Cropland	35	Ac	1,400	49,000
	(3) Woodland	189	Ac	500	94,500
	(4) Woodland	167	Ac	300	50,100
	Subtotal	582			$575,600
	b. Temporary Material Disposal Easement (3yrs)				
	(1) Cropland	182	Ac	$1,500	$273,000
	(2) Cropland	41	Ac	800	32,800
	(3) Cropland	90	Ac	1,050	94,500
	(4) Cropland	15	Ac	560	8,400
	(5) Woodland	196	Ac	400	78,400
	(6) Woodland	7	Ac	240	1,680
	Subtotal	531			$488,780
	Improvements				0
	Severance Damage				0
	Subtotal	1,113			$1,064,380
	Subtotal (R)				$1,064,000
	Contingencies (±25%)				266,000
	Acquisition Cost	120	tracts	$1,400	168,000
	Total--Lands and Damages				$1,498,000
02.	Relocations				
	a. Bridge (Lt. Dty.), R. Rigolette, Mi. 3.2	125	LF	$1,450	$181,300
	b. Bridge (Lt. Dty.), R. Rigolette, Mi. 11.8	100	LF	1,450	145,000

TABLE C-4-3 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
02.	Relocations (Continued)				
	c. Bridge (Lt. Dty.), B. Rigolette, Mi. 15.9	75	LF	$1,450	$ 108,800
	d. Bridge (Med. Dty.), B. Rigolette, Mi. 16.3	75	LF	1,550	116,300
	e. Bridge (Hvy. Dty.), B. Rigolette, Mi. 16.9	75	LF	2,065	154,900
	f. Bridge (Lt. Dty.), B. Darrow, Mi. 3.9	75	LF	1,450	108,800
	g. Bridge (Med. Dty.), B. Darrow, Mi. 6.6	75	LF	1,550	116,300
	h. Bridge, RR, Saline B.--Div. Ch., Mi. 2.1	50	LF	2,065	103,300
	i. Bridge, RR, B. Rigolette, Mi. 0.1	125	LF	2,065	258,200
	j. Gas Pipeline, 8" diameter, B. Rigolette, Mi. 6.5	250	LF	125	31,300
	k. Gas Pipeline, B. Rigolette, Mi. 9.8				
	(1) 26" diameter	225	LF	220	49,500
	(2) 30" diameter	225	LF	290	65,300
	(3) 36" diameter	225	LF	385	86,700
	l. Gas Pipeline, Saline B., Mi. 2.1				
	(1) 26" diameter	200	LF	220	44,000
	(2) 30" diameter	200	LF	290	58,000
	(3) 36" diameter	200	LF	385	77,000
	Subtotal (R)				$1,705,000
	Contingencies (±25%)				426,000
	Total--Relocations				$2,131,000
	SUMMARY OF NON-FEDERAL COSTS				
01.	Lands and Damages				$1,498,000
02.	Relocations				2,131,000
	TOTAL NON-FEDERAL COST				$3,629,000

TABLE C-4-3 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
09.	Channels				
	a. Bayou Rigolette				
	(1) Mobilization & demobilization		L.S.		$ 50,000
	(2) Excavation	1,929,000	CY	$ 1.50	2,893,500
	(3) Clearing	584	Ac	1,200	700,800
	(4) Dress & seed disposal banks	334	Ac	350	116,900
	(5) Clear & snag channel	1.85	Mi	15,000	27,800
	Subtotal				$3,789,000
	b. Bayou Darrow				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Excavation	80,000	CY	$ 2.50	200,000
	(3) Clearing	120	Ac	1,200	144,000
	(4) Dres & seed disposal banks	36	Ac	350	12,600
	(5) Clea snag channel	1.75	Mi	15,000	26,300
	Subtotal				$417,900
	c. Bayou Marteau				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	4.0	Mi	$12,000	48,000
	(3) Clear berm & disposal areas	54	Ac	1,200	64,800
	Subtotal				$137,800
	d. Bayou Sam				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	5.0	Mi	$12,000	60,000
	(3) Clear berm & disposal areas	36	Ac	1,200	43,200
	Subtotal				$128,200
	e. Bayou Saline				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Excavation	435,000	CY	$ 1.50	652,500
	(3) Clearing	127	Ac	1,200	152,400
	(4) Dress & seed disposal banks	73	Ac	350	25,600
	Subtotal				$865,500

TABLE C-4-3 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
09.	Channels (Continued)				
	f. Bayou DuGrappe & Sugarhouse				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Excavation	131,000	CY	$ 2.50	327,500
	(3) Clearing	89	Ac	1,200	106,800
	(4) Dress & seed disposal banks	45	Ac	350	15,800
	(5) Clear & snag channel	12.2	Mi	8,000	97,600
	Subtotal				$572,700
	Subtotal				$5,911,100
	Contingencies (±25%)				1,477,900
	Total--Channels				$7,389,000
	SUMMARY OF FEDERAL COSTS				
09.	Channels				$7,389,000
30.	Engineering & Design (±13%)1/				972,000
	Engineering & Design--Acquisition				9,000
31.	Supervision & Administration (±8%)				601,000
	TOTAL FEDERAL COST				$8,971,000
	TOTAL PROJECT FIRST COST				$12,600,000

1/ Includes pre-construction planning estimate.

TABLE C-4-4

FIRST COST

Plan 5A
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Woodland	11	Ac	$500	$ 5,500
	b. Temporary Construction Easement				
	(1) Woodland	9	Ac	$150	$ 1,350
	Improvements				0
	Severance Damage				3,250
	Subtotal	20			$10,100
	Subtotal (R)				$10,000
	Contingencies (±25%)				2,000
	Acquisition Cost				1,000
	Total--Lands and Damages				$13,000
	TOTAL NON-FEDERAL COST				$13,000

TABLE C-4-4 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
15.	Floodgates				
	a. Clear & grub	20	Ac	$1,200	$ 24,000
	b. Cofferdam--protective	46,875	CY	2.50	117,188
	c. Cofferdam--floodside	93,870	CY	2.50	234,675
	d. Channel excavation	73,986	CY	1.50	110,979
	e. Levee excavation	33,632	CY	1.50	50,448
	f. Structural excavation	13,446	CY	2.50	33,615
	g. Sand backfill	740	CY	20	14,800
	h. Pervious backfill	392	CY	20	7,840
	i. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	j. Structural backfill	2,283	CY	7	15,981
	k. Semi-compacted levee	73,190	CY	3	219,570
	l. Seed & fertilize	18	Ac	700	13,300
	m. Riprap	1,079	tons	30	32,370
	n. Plastic filter cloth	17,270	SF	0.50	8,635
	o. Dewatering		L.S.		300,000
	p. Concrete				
	(1) Stabilizing slab	132	CY	100	13,200
	(2) Culvert	1,260	CY	300	378,000
	(3) Alinement collars	150	CY	400	60,000
	(4) Inlet & outlet monoliths	454	CY	300	136,200
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	80	CY	500	40,000
	(7) Stoplogs	24	CY	300	7,200
	q. Sluice gate	2	Ea.	30,000	60,000
	r. Machinery platform	1,800	lb.	3	5,400
	s. Walk bridge (precast prestress)	1	Ea.		25,000
	t. Handrail	320	LF	25	8,000
	u. Steel sheet pile (pz-27)	690	SF	12.50	8,625
	v. Waterstops	940	LF	8	7,520
	w. Perforated pipe (6" diameter pvc)	135	LF	25	3,375
	x. Electrical work		L.S.		25,000
	y. Operating equipment		L.S.		112,500
	z. Road maintenance	3	Mi		200,000
	aa. Mobilization & demobilization		L.S.		50,000
	bb. Floodside cofferdam--emergency	39,530	CY	3	118,590
	Subtotal				$2,452,011
	Contingencies (±25%)				647,989
	Total--Floodgates				$3,100,000

TABLE C-4-4 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	SUMMARY OF FEDERAL COSTS				
15.	Floodgates				$3,100,000
30.	Engineering & Design (±31%)1/				965,000
	Engineering & Design--Acquisition				1,000
31.	Supervision & Administration (±11%)				341,000
	TOTAL FEDERAL COST				$4,407,000
	TOTAL PROJECT FIRST COST				$4,420,000

1/ Includes pre-construction planning estimate.

TABLE C-4-5

FIRST COST

Plan 5B
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Woodland	11	Ac	$500	$ 5,500
	b. Temporary Construction Easement				
	(1) Woodland	9	Ac	$150	$ 1,350
	Improvements				0
	Severance Damage				3,250
	Subtotal	20			$10,100
	Subtotal (R)				$10,000
	Contingencies (±25%)				2,000
	Acquisition Cost				1,000
	Total--Lands and Damages				$13,000
	TOTAL NON-FEDERAL COST				$13,000

TABLE C-4-5 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
15.	Floodgates				
	a. Clear & grub	20	Ac	$1,200	$ 24,000
	b. Cofferdam--protective	48,260	CY	2.50	120,650
	c. Cofferdam--floodside	96,340	CY	2.50	240,850
	d. Channel excavation	73,986	CY	1.50	110,979
	e. Levee excavation	41,772	CY	1.50	62,658
	f. Structural excavation	17,252	CY	2.50	43,130
	g. Sand backfill	783	CY	20	15,660
	h. Pervious backfill	392	CY	20	7,840
	i. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	j. Structural backfill	2,574	CY	7	18,018
	k. Semi-compacted levee	77,035	CY	3	231,105
	l. Seed & fertilize	19	Ac	700	13,300
	m. Riprap	1,301	tons	30	39,030
	n. Plastic filter cloth	21,670	SF	0.50	10,835
	o. Dewatering		L.S.		300,000
	p. Concrete				
	(1) Stabilizing slab	265	CY	100	26,500
	(2) Culvert	2,330	CY	300	699,000
	(3) Alinement collars	263	CY	400	105,200
	(4) Inlet & outlet monoliths	770	CY	300	231,000
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	146	CY	500	73,000
	(7) Stoplogs	48	CY	300	14,400
	q. Sluice gate	4	Ea.	30,000	120,000
	r. Machinery platform	3,600	lb.	3	10,800
	s. Walk bridge (precast prestress)	1	Ea.		25,000
	t. Handrail	560	LF	25	14,000
	u. Steel sheet pile (pz-27)	1,380	SF	12.50	17,250
	v. Waterstops	1,880	LF	8	15,040
	w. Perforated pipe (6" diameter pvc)	160	LF	25	4,000
	x. Electrical work		L.S.		25,000
	y. Operating equipment		L.S.		225,000
	z. Road maintenance	3	Mi		200,000
	aa. Mobilization & demobilization		L.S.		50,000
	bb. Floodside cofferdam--emergency	39,530	CY	3	118,590
	Subtotal				$3,221,835
	Contingencies (±25%)				808,165
	Total--Floodgates				$4,030,000

TABLE C-4-5 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	SUMMARY OF FEDERAL COSTS				
15.	Floodgates				$4,030,000
30.	Engineering & Design (±28%)1/				1,133,000
	Engineering & Design--Acquisition				1,000
31.	Supervision & Administration (±11%)				443,000
	TOTAL FEDERAL COST				$5,607,000
	TOTAL PROJECT FIRST COST				$5,620,000

1/ Includes pre-construction planning estimate.

TABLE C-4-6

FIRST COST

Plan 5C
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Woodland	11	Ac	$500	$ 5,500
	b. Temporary Construction Easement				
	(1) Woodland	9	Ac	$150	$ 1,350
	Improvements				0
	Severance Damage				3,250
	Subtotal	20			$10,100
	Subtotal (R)				$10,000
	Contingencies (±25%)				2,000
	Acquisition Cost				1,000
	Total--Lands and Damages				$13,000
	TOTAL NON-FEDERAL COST				$13,000

TABLE C-4-6 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
15.	Floodgates				
	a. Clear & grub	20	Ac	$1,200	$ 24,000
	b. Cofferdam--protective	49,645	CY	2.50	124,113
	c. Cofferdam--floodside	98,810	CY	2.50	247,025
	d. Channel excavation	73,986	CY	1.50	110,979
	e. Levee excavation	49,912	CY	1.50	74,868
	f. Structural excavation	21,057	CY	2.50	52,642
	g. Sand backfill	830	CY	20	16,600
	h. Pervious backfill	392	CY	20	7,840
	i. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	j. Structural backfill	2,866	CY	7	20,062
	k. Semi-compacted levee	81,235	CY	3	243,705
	l. Seed & fertilize	20	Ac	700	14,000
	m. Riprap	1,568	tons	30	47,040
	n. Plastic filter cloth	26,232	SF	0.50	13,116
	o. Dewatering		L.S.		300,000
	p. Concrete				
	(1) Stabilizing slab	397	CY	100	39,700
	(2) Culvert	3,400	CY	300	1,020,000
	(3) Alinement collars	375	CY	400	150,000
	(4) Inlet & outlet monoliths	1,090	CY	300	327,000
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	216	CY	500	108,000
	(7) Stoplogs	72	CY	300	21,600
	q. Sluice gate	6	Ea.	30,000	180,000
	r. Machinery platform	7,200	lb.	3	21,600
	s. Walk bridge (precast prestress)	1	Ea.		25,000
	t. Handrail	800	LF	25	20,000
	u. Steel sheet pile (pz-27)	2,070	SF	12.50	25,875
	v. Waterstops	2,820	LF	8	22,560
	w. Perforated pipe (6" diameter pvc)	200	LF	25	5,000
	x. Electrical work		L.S.		25,000
	y. Operating equipment		L.S.		337,500
	z. Road maintenance	3	Mi		200,000
	aa. Mobilization & demobilization		L.S.		50,000
	bb. Floodside cofferdam--emergency	39,530	CY	3	118,590
	Subtotal				$4,003,415
	Contingencies (±25%)				996,585
	Total--Floodgates				$5,000,000

TABLE C-4-6

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	SUMMARY OF FEDERAL COSTS				
15.	Floodgates				$5,000,000
30.	Engineering & Design (±25%)[1]				1,250,000
	Engineering & Design--Acquisition				1,000
31.	Supervision & Administration (±11%)				556,000
	TOTAL FEDERAL COST				$6,807,000
	TOTAL PROJECT FIRST COST				$6,820,000

[1] Includes pre-construction planning estimate.

TABLE C-4-7

FIRST COST

Plan 5D
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Woodland	11	Ac	$500	$ 5,500
	b. Temporary Construction Easement				
	(1) Woodland	9	Ac	$150	$ 1,350
	Improvements				0
	Severance Damage				3,250
	Subtotal	20			$10,100
	Subtotal (R)				$10,000
	Contingencies (±25%)				2,000
	Acquisition Cost				1,000
	Total--Lands and Damages				$13,000
	TOTAL NON-FEDERAL COST				$13,000

TABLE C-4-7 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
15.	Floodgates				
	a. Clear & grub	20	Ac	$1,200	$ 24,000
	b. Cofferdam--protective	51,000	CY	2.50	127,500
	c. Cofferdam--floodside	101,300	CY	2.50	253,250
	d. Channel excavation	96,700	CY	1.50	145,050
	e. Levee excavation	58,100	CY	1.50	87,150
	f. Structural excavation	24,900	CY	2.50	62,250
	g. Sand backfill	877	CY	20	17,540
	h. Pervious backfill	400	CY	20	8,000
	i. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	j. Structural backfill	3,200	CY	7	22,400
	k. Semi-compacted levee	85,402	CY	3	256,206
	l. Seed & fertilize	20	Ac	700	14,000
	m. Riprap	1,840	tons	30	55,200
	n. Plastic filter cloth	30,800	SF	0.50	15,400
	o. Dewatering		L.S.		325,000
	p. Concrete				
	(1) Stabilizing slab	410	CY	100	41,000
	(2) Culvert	4,470	CY	300	1,341,000
	(3) Alinement collars	490	CY	400	196,000
	(4) Inlet & outlet monoliths	1,100	CY	300	330,000
	(5) Wing walls	70	CY	300	21,000
	(6) Gate tower	240	CY	500	120,000
	(7) Stoplogs	96	CY	300	28,800
	q. Sluice gate	8	Ea.	30,000	240,000
	r. Machinery platform	7,200	lb.	3	21,600
	s. Walk bridge (precast prestress)	1	Ea.		25,000
	t. Handrail	1,040	LF	25	26,000
	u. Steel sheet pile (pz-27)	2,800	SF	12.50	35,000
	v. Waterstops	3,760	LF	8	30,080
	w. Perforated pipe (6" diameter pvc)	240	LF	25	6,000
	x. Electrical work		L.S.		30,000
	y. Operating equipment		L.S.		450,000
	z. Road maintenance	3	Mi		200,000
	aa. Mobilization & demobilization		L.S.		50,000
	bb. Floodside cofferdam--emergency	39,530	CY	3	118,590
	Subtotal				$4,726,416
	Contingencies (±25%)				1,173,584
	Total--Floodgates				$5,900,000

TABLE C-4-7 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	SUMMARY OF FEDERAL COSTS				
15.	Floodgates				$5,900,000
30.	Engineering & Design (±25%)1/				1,475,000
	Engineering & Design--Acquisition				1,000
31.	Supervision & Administration (±11%)				651,000
	TOTAL FEDERAL COST				$8,027,000
	TOTAL PROJECT FIRST COST				$8,040,000

1/ Includes pre-construction planning estimate.

TABLE C-4-8

FIRST COST

Plan 6A
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Cropland	43	Ac	$2,000	$ 86,000
	(2) Cropland	22	Ac	1,400	30,800
	(3) Woodland	45	Ac	500	22,500
	(4) Woodland	51	Ac	300	15,300
	(5) Woodland	7	Ac	N/C	0
	Subtotal	168			$154,600
	b. Temporary Material Disposal Easement (3 yrs.)				
	(1) Cropland	52	Ac	$1,500	$ 78,000
	(2) Cropland	33	Ac	800	26,400
	(3) Cropland	34	Ac	1,050	35,700
	(4) Cropland	15	Ac	560	8,400
	(5) Woodland	59	Ac	400	23,600
	(6) Woodland	5	Ac	240	1,200
	Subtotal	198			$173,300
	Improvements				0
	Severance Damage				0
	Subtotal	366			$327,900
	Subtotal (R)				$328,000
	Contingencies (±25%)				82,000
	Acquisition Cost	51	tracts	$1,400	71,000
	Total--Lands and Damages				$481,000
	TOTAL NON-FEDERAL COST				$481,000

TABLE C-4-8 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
04.	Earthen Closure				
	a. Bayou Rigolette				
	(1) Levee fill	23,840	CY	$ 2.50	$59,600
	(2) Gravel crown	56	CY	20	1,120
	(3) Fertilize & seed	6	Ac	700	4,200
	(4) Clear & grub	4	Ac	1,200	4,800
	(5) Environmental protection		L.S.		500
	(6) Mobilization & demobilization		L.S.		25,000
	Subtotal				$95,220
	a. Bayou Saline				
	(1) Levee fill	15,550	CY	$ 2.50	$38,875
	(2) Gravel crown	56	CY	20	1,120
	(3) Fertilize & seed	6	Ac	700	4,200
	(4) Clear & grub	4	Ac	1,200	4,800
	(5) Environmental protection		L.S.		500
	(6) Mobilization & demobilization		L.S.		25,000
	Subtotal				$74,495
	Subtotal				$169,715
	Contingencies (±25%)				42,285
	Total--Earthen Closures				$212,000
09.	Channels				
	a. Bayou Darrow				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Clearing	167	Ac	$1,200	200,400
	(3) Dress & seed disposal banks	93	Ac	350	32,550
	(4) Excavation	596,585	CY	2.50	1,491,500
	Subtotal				$1,759,450
	b. Bayou Rigolette				
	(1) Mobilization & demobilization		L.S.		$ 50,000
	(2) Clearing	103	Ac	$1,200	123,600
	(3) Dress & seed disposal banks	47	Ac	350	16,450
	(4) Excavation	197,224	CY	1.75	345,100
	(5) Clear & snag channel	2.53	Mi	1,500	37,950
	Subtotal				$573,100

TABLE C-4-8 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
09.	Channels (Continued)				
	c. Bayou Sam				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Clear berm & disposal areas	64	Ac	$ 1,200	76,800
	(3) Clear & snag channel	4.4	Mi	12,000	52,800
	Subtotal				$154,600
	d. Bayou Saline				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Clear berm & disposal areas	73	Ac	$ 1,200	87,600
	(3) Clear & snag channel	5.5	Mi	8,000	44,000
	Subtotal				$166,600
	e. Removal of Earthen Closure (Bayou Rigolette)				
	(1) Clearing	9	Ac	$ 1,200	$ 10,800
	(2) Dress & seed disposal banks	7	Ac	350	2,450
	(3) Excavation	145,800	CY	1.75	255,150
	Subtotal				$268,400
	Subtotal				$2,922,150
	Contingencies (±25%)				730,850
	Total--Channels				$3,653,000
15.	Floodgates				
	a. Clear & grub	13	Ac	$ 1,200	$ 15,600
	b. Cofferdam--landside	38,970	CY	2.50	97,425
	c. Cofferdam--floodside	125,283	CY	2.50	313,208
	d. Channel excavation	30,000	CY	1.50	45,000
	e. Levee excavation	59,700	CY	1.50	89,550
	f. Sand backfill	783	CY	20	15,660
	g. Pervious backfill	392	CY	20	7,840
	h. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	i. Structural backfill	3,481	CY	7	24,367
	j. Semi-compacted levee	63,576	CY	3	190,728
	k. Seed & fertilize	13	Ac	700	9,100
	l. Riprap	1,301	tons	30	39,030
	m. Plastic filter cloth	21,670	SF	0.50	10,835
	n. Dewatering		L.S.		300,000

TABLE C-4-8 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	o. Concrete				
	(1) Stabilizing slab	418	CY	$ 100	$ 41,800
	(2) Culvert	3,145	CY	300	943,500
	(3) Alinement collars	330	CY	400	132,000
	(4) Inlet & outlet monoliths	770	CY	300	231,000
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	146	CY	500	73,000
	(7) Stoplogs	48	CY	300	14,400
	p. Sluice gate	4	Ea.	30,000	120,000
	q. Machinery platform	3,600	lb.	3	10,800
	r. Walk bridge (precast prestress)	1	Ea.		25,000
	s. Handrail	560	LF	25	14,000
	t. Steel sheet pile (pz-27)	1,380	SF	12.50	17,250
	u. Waterstops	1,880	LF	8	15,040
	v. Perforated pipe (6" diameter pvc)	160	LF	25	4,000
	w. Electrical work		LS		25,000
	x. Operating equipment		LS		225,000
	y. Road maintenance	5	Mi	60,000	300,000
	z. Mobilization & demobilization		LS		50,000
	aa. Floodside cofferdam--emergency	40,000	CY	3	120,000
	bb. Semi-compacted levee	48,800	CY	3	146,400
	Subtotal				$3,676,533
	Contingencies (±25%)				923,467
	Total--Floodgates				$4,600,000
	SUMMARY OF FEDERAL COSTS				
04.	Earthen Closures				$ 212,000
09.	Channels				3,653,000
15.	Floodgates				4,600,000
	Subtotal				$8,465,000
30.	Engineering & Design (±21%)1/				$1,799,000
	Engineering & Design--Acquisition				5,000
31.	Supervision & Administration (±10%)				850,000
	TOTAL FEDERAL COST				$11,119,000
	TOTAL PROJECT FIRST COST				$11,600,000

1/ Includes pre-construction planning estimate.

TABLE C-4-9

FIRST COST

Plan 6B
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Cropland	43	Ac	$2,000	$ 86,000
	(2) Cropland	22	Ac	1,400	30,800
	(3) Woodland	45	Ac	500	22,500
	(4) Woodland	51	Ac	300	15,300
	(5) Woodland	7	Ac	N/C	0
	Subtotal	168			$154,600
	b. Temporary Material Disposal Easement (3 yrs.)				
	(1) Cropland	33	Ac	$1,500	$49,500
	(2) Cropland	32	Ac	800	25,600
	(3) Cropland	25	Ac	1,050	26,250
	(4) Cropland	15	Ac	560	8,400
	(5) Woodland	44	Ac	400	17,600
	(6) Woodland	6	Ac	240	1,440
	Subtotal	155			$128,790
	Improvements				0
	Severance Damage				0
	Subtotal	323			$283,390
	Subtotal (R)				$283,000
	Contingencies (±25%)				71,000
	Acquisition Cost	51	tracts	$1,400	71,000
	Total--Lands and Damages				$425,000
	TOTAL NON-FEDERAL COST				$425,000

TABLE C-4-9 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
04.	Earthen Closure				
	a. Bayou Rigolette				
	(1) Levee fill	23,840	CY	$ 2.50	$59,600
	(2) Gravel crown	56	CY	20	1,120
	(3) Fertilize & seed	6	Ac	700	4,200
	(4) Clear & grub	4	Ac	1,200	4,800
	(5) Environmental protection		L.S.		500
	(6) Mobilization & demobilization		L.S.		25,000
	Subtotal				$95,220
	a. Bayou Saline				
	(1) Levee fill	15,550	CY	$ 2.50	$38,875
	(2) Gravel crown	56	CY	20	1,120
	(3) Fertilize & seed	6	Ac	700	4,200
	(4) Clear & grub	4	Ac	1,200	4,800
	(5) Environmental protection		L.S.		500
	(6) Mobilization & demobilization		L.S.		25,000
	Subtotal				$74,495
	Subtotal				$169,715
	Contingencies (±25%)				42,285
	Total--Earthen Closures				$212,000
09.	Channels				
	a. Bayou Darrow				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Clearing	139	Ac	$ 1,200	166,800
	(3) Dress & seed disposal banks	65	Ac	350	22,750
	(4) Excavation	294,252	CY	2.50	735,630
	Subtotal				$960,180
	b. Bayou Rigolette				
	(1) Mobilization & demobilization		L.S.		$ 50,000
	(2) Clearing	80	Ac	$ 1,200	96,000
	(3) Dress & seed disposal banks	32	Ac	350	11,200
	(4) Excavation	85,372	CY	1.75	149,400
	(5) Clear & snag channel	2.53	Mi	1,500	37,950
	Subtotal				$344,550

TABLE C-4-9 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
09.	Channels (Continued)				
	c. Bayou Sam				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Clear berm & disposal areas	64	Ac	$ 1,200	76,800
	(3) Clear & snag channel	4.4	Mi	12,000	52,800
	Subtotal				$154,600
	d. Bayou Saline				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Clear berm & disposal areas	73	Ac	$ 1,200	87,600
	(3) Clear & snag channel	5.5	Mi	8,000	44,000
	Subtotal				$166,600
	e. Removal of Earthen Closure (Bayou Rigolette)				
	(1) Clearing	9	Ac	$ 1,200	$ 10,800
	(2) Dress & seed disposal banks	7	Ac	350	2,450
	(3) Excavation	145,800	CY	1.75	255,150
	Subtotal				$268,400
	Subtotal				$1,894,330
	Contingencies (±25%)				473,670
	Total--Channels				$2,368,000
15.	Floodgates				
	a. Clear & grub	13.5	Ac	$1,200	$ 16,200
	b. Cofferdam--landside	39,730	CY	2.50	99,325
	c. Cofferdam--floodside	127,647	CY	2.50	319,118
	d. Channel excavation	31,029	CY	1.50	46,543
	e. Levee excavation	62,189	CY	1.50	93,283
	f. Sand backfill	800	CY	20	160,000
	g. Pervious backfill	392	CY	20	7,840
	h. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	i. Structural backfill	3,678	CY	7	25,746
	j. Semi-compacted levee	66,289	CY	3	198,867
	k. Seed & fertilize	13.5	Ac	700	9,450
	l. Riprap	1,435	tons	30	43,050
	m. Plastic filter cloth	24,000	SF	0.50	12,000
	n. Dewatering		L.S.		300,000

TABLE C-4-9 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	o. Concrete				
	(1) Stabilizing slab	522	CY	$ 100	$ 52,200
	(2) Culvert	3,868	CY	300	1,160,400
	(3) Alinement collars	555	CY	400	220,000
	(4) Inlet & outlet monoliths	875	CY	300	262,500
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	184	CY	500	92,000
	(7) Stoplogs	60	CY	300	18,000
	p. Sluice gate	5	Ea.	30,000	150,000
	q. Machinery platform	4,500	lb.	3	13,500
	r. Walk bridge (precast prestress)	1	Ea.		25,000
	s. Handrail	680	LF	25	17,000
	t. Steel sheet pile (pz-27)	1,725	SF	12.50	21,562
	u. Waterstops	2,350	LF	8	18,800
	v. Perforated pipe (6" diameter pvc)	180	LF	25	4,500
	w. Electrical work		LS		25,000
	x. Operating equipment		LS		281,250
	y. Road maintenance	5	Mi	60,000	300,000
	z. Mobilization & demobilization		LS		50,000
	aa. Floodside cofferdam--emergency	40,000	CY	3	120,000
	bb. Semi-compacted levee	48,800	CY	3	146,400
	Subtotal				$4,319,534
	Contingencies (±25%)				1,080,466
	Total--Floodgates				$5,400,000
	SUMMARY OF FEDERAL COSTS				
04.	Earthen Closures				$ 212,000
09.	Channels				2,368,000
15.	Floodgates				5,400,000
	Subtotal				$7,980,000
30.	Engineering & Design (±23%) 1/				$1,800,000
	Engineering & Design--Acquisition				5,000
31.	Supervision & Administration (±10%)				790,000
	TOTAL FEDERAL COST				$10,575,000
	TOTAL PROJECT FIRST COST				$11,000,000

1/ Includes pre-construction planning estimate.

TABLE C-4-10

FIRST COST

Plan 6C
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Cropland	43	Ac	$2,000	$ 86,000
	(2) Cropland	22	Ac	1,400	30,800
	(3) Woodland	45	Ac	500	22,500
	(4) Woodland	51	Ac	300	15,300
	(5) Woodland	7	Ac	N/C	0
	Subtotal	168			$154,600
	b. Temporary Material Disposal Easement (3 yrs.)				
	(1) Cropland	59	Ac	$ 800	$47,200
	(2) Cropland	4	Ac	1,050	4,200
	(3) Cropland	32	Ac	560	17,920
	(4) Woodland	13	Ac	400	5,200
	(5) Woodland	26	Ac	240	6,240
	Subtotal	134			$80,760
	Improvements				0
	Severance Damage				0
	Subtotal	302			$235,360
	Subtotal (R)				$235,000
	Contingencies (±25%)				59,000
	Acquisition Cost	51	tracts	$1,400	71,000
	Total--Lands and Damages				$365,000
	TOTAL NON-FEDERAL COST				$365,000

TABLE C-4-10 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
04.	Earthen Closure				
	a. Bayou Rigolette				
	(1) Levee fill	23,840	CY	$ 2.50	$59,600
	(2) Gravel crown	56	CY	20	1,120
	(3) Fertilize & seed	6	Ac	700	4,200
	(4) Clear & grub	4	Ac	1,200	4,800
	(5) Environmental protection		L.S.		500
	(6) Mobilization & demobilization		L.S.		25,000
	Subtotal				$95,220
	a. Bayou Saline				
	(1) Levee fill	15,550	CY	$ 2.50	$38,875
	(2) Gravel crown	56	CY	20	1,120
	(3) Fertilize & seed	6	Ac	700	4,200
	(4) Clear & grub	4	Ac	1,200	4,800
	(5) Environmental protection		L.S.		500
	(6) Mobilization & demobilization		L.S.		25,000
	Subtotal				$74,495
	Subtotal				$169,715
	Contingencies (±25%)				42,285
	Total--Earthen Closures				$212,000
09.	Channels				
	a. Bayou Darrow				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Clearing	121	Ac	$ 1,200	145,200
	(3) Dress & seed disposal banks	9	Ac	350	3,150
	(4) Excavation	68,944	CY	2.50	172,360
	(5) Clear & snag channel	7.17	Mi	15,000	107,550
	Subtotal				$463,260
	b. Bayou Rigolette				
	(1) Mobilization & demobilization		L.S.		$ 50,000
	(2) Clearing	84	Ac	$ 1,200	100,800
	(3) Clear & snag channel	5.74	Mi	15,000	86,100
	Subtotal				$236,900

TABLE C-4-10 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
09.	Channels (Continued)				
	c. Bayou Sam				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Clear berm & disposal areas	64	Ac	$ 1,200	76,800
	(3) Clear & snag channel	4.4	Mi	12,000	52,800
	Subtotal				$154,600
	d. Bayou Saline				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Clear berm & disposal areas	73	Ac	$ 1,200	87,600
	(3) Clear & snag channel	5.5	Mi	8,000	44,000
	Subtotal				$166,600
	e. Removal of Earthen Closure (Bayou Rigolette)				
	(1) Clearing	9	Ac	$ 1,200	$ 10,800
	(2) Dress & seed disposal banks	7	Ac	350	2,450
	(3) Excavation	145,800	CY	1.75	255,150
	Subtotal				$268,400
	Subtotal				$1,289,760
	Contingencies (±25%)				322,240
	Total--Channels				$1,612,000
15.	Floodgates				
	a. Clear & grub	14	Ac	$1,200	$ 16,800
	b. Cofferdam--landside	40,487	CY	2.50	101,218
	c. Cofferdam--floodside	130,011	CY	2.50	325,028
	d. Channel excavation	32,000	CY	1.50	48,000
	e. Levee excavation	64,644	CY	1.50	96,966
	f. Sand backfill	830	CY	20	16,600
	g. Pervious backfill	392	CY	20	7,840
	h. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	i. Structural backfill	3,876	CY	7	27,132
	j. Semi-compacted levee	69,001	CY	3	207,003
	k. Seed & fertilize	14	Ac	700	9,800
	l. Riprap	1,568	tons	30	47,040
	m. Plastic filter cloth	26,232	SF	0.50	13,116
	n. Dewatering		L.S.		300,000

TABLE C-4-10 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	o. Concrete				
	(1) Stabilizing slab	627	CY	$ 100	$ 62,700
	(2) Culvert	4,590	CY	300	1,377,000
	(3) Alinement collars	659	CY	400	263,600
	(4) Inlet & outlet monoliths	950	CY	300	285,000
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	219	CY	500	109,500
	(7) Stoplogs	72	CY	300	21,600
	p. Sluice gate	6	Ea.	30,000	180,000
	q. Machinery platform	7,200	lb.	3	21,600
	r. Walk bridge (precast prestress)	1	Ea.		25,000
	s. Handrail	800	LF	20	16,000
	t. Steel sheet pile (pz-27)	2,070	SF	12.50	25,900
	u. Waterstops	2,820	LF	8	22,560
	v. Perforated pipe (6" diameter pvc)	200	LF	25	5,000
	w. Electrical work		L.S.		25,000
	x. Operating equipment		L.S.		337,500
	y. Road maintenance	5	Mi		300,000
	z. Mobilization & demobilization		L.S.		50,000
	aa. Floodside cofferdam--emergency	40,000	CY	3	120,000
	bb. Semi-compacted levee	48,800	CY	3	146,400
	Subtotal				$4,630,903
	Contingencies (±25%)				1,169,097
	Total--Floodgates				$5,800,000
	SUMMARY OF FEDERAL COSTS				
04.	**Earthen Closures**				$ 212,000
09.	**Channels**				1,612,000
15.	**Floodgates**				5,800,000
	Subtotal				$7,624,000
30.	Engineering & Design (±25%)1/				$1,934,000
	Engineering & Design--Acquisition				5,000
31.	Supervision & Administration (±10%)				772,000
	TOTAL FEDERAL COST				$10,335,000
	TOTAL PROJECT FIRST COST				$10,700,000

1/ Includes pre-construction planning estimate.

TABLE C-4-10a

FIRST COST

Plan 6D
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Cropland	43	Ac	$2,000	$ 86,000
	(2) Cropland	22	Ac	1,400	30,800
	(3) Woodland	45	Ac	500	22,500
	(4) Woodland	51	Ac	300	15,300
	(5) Woodland	7	Ac	N/C	0
	Subtotal	168			$154,600
	b. Temporary Material Disposal Easement (3 yrs.)				
	(1) Cropland	59	Ac	$ 800	$47,200
	(2) Cropland	4	Ac	1,050	4,200
	(3) Cropland	32	Ac	560	17,920
	(4) Woodland	13	Ac	400	5,200
	(5) Woodland	26	Ac	240	6,240
	Subtotal	134			$80,760
	Improvements				0
	Severance Damage				0
	Subtotal	302			$235,360
	Subtotal (R)				$235,000
	Contingencies (±25%)				59,000
	Acquisition Cost	51	tracts	$1,400	71,000
	Total--Lands and Damages				$365,000
	TOTAL NON-FEDERAL COST				$365,000

TABLE C-4-10a(CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
04.	Earthen Closure				
	a. Bayou Rigolette				
	(1) Levee fill	23,840	CY	$ 2.50	$59,600
	(2) Gravel crown	56	CY	20	1,120
	(3) Fertilize & seed	6	Ac	700	4,200
	(4) Clear & grub	4	Ac	1,200	4,800
	(5) Environmental protection		L.S.		500
	(6) Mobilization & demobilization		L.S.		25,000
	Subtotal				$95,220
	a. Bayou Saline				
	(1) Levee fill	15,550	CY	$ 2.50	$38,875
	(2) Gravel crown	56	CY	20	1,120
	(3) Fertilize & seed	6	Ac	700	4,200
	(4) Clear & grub	4	Ac	1,200	4,800
	(5) Environmental protection		L.S.		500
	(6) Mobilization & demobilization		L.S.		25,000
	Subtotal				$74,495
	Subtotal				$169,715
	Contingencies (±25%)				42,285
	Total--Earthen Closures				$212,000
09.	Channels				
	a. Bayou Darrow				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Clearing	121	Ac	$ 1,200	145,200
	(3) Dress & seed disposal banks	9	Ac	350	3,150
	(4) Excavation	68,944	CY	2.50	172,360
	(5) Clear & snag channel	7.17	Mi	15,000	107,550
	Subtotal				$463,260
	b. Bayou Rigolette				
	(1) Mobilization & demobilization		L.S.		$ 50,000
	(2) Clearing	84	Ac	$ 1,200	100,800
	(3) Clear & snag channel	5.74	Mi	15,000	86,100
	Subtotal				$236,900

TABLE C-4-10a(CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
09.	Channels (Continued)				
	c. Bayou Sam				
	(1) Mobilization & demobilization		L.S.		$ 25,000
	(2) Clear berm & disposal areas	64	Ac	$ 1,200	76,800
	(3) Clear & snag channel	4.4	Mi	12,000	52,800
	Subtotal				$154,600
	d. Bayou Saline				
	(1) Mobilization & demobilization		L.S.		$ 35,000
	(2) Clear berm & disposal areas	73	Ac	$ 1,200	87,600
	(3) Clear & snag channel	5.5	Mi	8,000	44,000
	Subtotal				$166,600
	e. Removal of Earthen Closure (Bayou Rigolette)				
	(1) Clearing	9	Ac	$ 1,200	$ 10,800
	(2) Dress & seed disposal banks	7	Ac	350	2,450
	(3) Excavation	145,800	CY	1.75	255,150
	Subtotal				$268,400
	Subtotal				$1,289,760
	Contingencies (±25%)				322,240
	Total--Channels				$1,612,000
15.	Floodgates				
	a. Clear & grub	16	Ac	$1,200	$ 19,200
	b. Cofferdam--landside	47,250	CY	2.50	118,125
	c. Cofferdam--floodside	151,720	CY	2.50	379,300
	d. Channel excavation	37,350	CY	1.50	56,025
	e. Levee excavation	75,440	CY	1.50	113,160
	f. Sand backfill	970	CY	20	19,400
	g. Pervious backfill	460	CY	20	9,200
	h. Gravel (gravel, clay, & sand)	200	CY	20	4,000
	i. Structural backfill	4,520	CY	7	31,640
	j. Semi-compacted levee	80,525	CY	3	241,575
	k. Seed & fertilize	16	Ac	700	11,200
	l. Riprap	1,830	Tons	30	54,900
	m. Plastic filter cloth	30,610	SF	0.50	15,305
	n. Dewatering		L.S.		300,000

TABLE C-4-10a (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	o. Concrete				
	(1) Stabilizing slab	730	CY	$ 100	$ 73,000
	(2) Culvert	5,360	CY	300	1,608,000
	(3) Alinement collars	770	CY	400	308,000
	(4) Inlet & outlet monoliths	1,110	CY	300	333,000
	(5) Wing walls	26	CY	300	7,800
	(6) Gate tower	255	CY	500	127,500
	(7) Stoplogs	84	CY	300	25,200
	p. Sluice gate	7	Ea.	30,000	210,000
	q. Machinery platform	8,400	lb.	3	25,200
	r. Walk bridge (precast prestress)	1	Ea.		25,000
	s. Handrail	935	LF	20	18,700
	t. Steel sheet pile (pz-27)	2,420	SF	12.50	30,250
	u. Waterstops	3,290	LF	8	26,320
	v. Perforated pipe (6" diameter pvc)	230	LF	25	5,750
	w. Electrical work		L.S.		25,000
	x. Operating equipment		L.S.		393,860
	y. Road maintenance	5	Mi		300,000
	z. Mobilization & demobilization		L.S.		50,000
	aa. Floodside cofferdam--emergency	40,000	CY	3	120,000
	bb. Semi-compacted levee	48,800	CY	3	146,400
	Subtotal				$5,232,010
	Contingencies (±25%)				1,307,990
	Total--Floodgates				$6,540,000
	SUMMARY OF FEDERAL COSTS				
04.	**Earthen Closures**				$ 212,000
09.	**Channels**				1,612,000
15.	Floodgates				6,540,000
	Subtotal				$8,364,000
30.	Engineering & Design (±25%)[1/]				$2,126,000
	Engineering & Design--Acquisition				5,000
31.	Supervision & Administration (±10%)				840,000
	TOTAL FEDERAL COST				$11,355,000
	TOTAL PROJECT FIRST COST				$11,700,000

1/ Includes pre-construction planning estimate.

TABLE C-4-11

FIRST COST

Plan 9B1
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Cropland	75	Ac	$2,000	$150,000
	(2) Cropland	13	Ac	1,400	18,200
	(3) Woods	130	Ac	500	65,000
	(4) Woods	32	Ac	300	9,600
	(5) Woods	11	Ac	500	5,500
		261			$248,300
	b. Temporary Material Disposal Easement (3 yrs.)				
	(1) Cropland	55		2,000 x .40	$ 44,000
	(2) Cropland	10		1,400 x .40	5,600
	(3) Woods	63		800 x .30	15,120
		128		800 x .30	$ 64,720
	c. Temporary Construction Easement (3 yrs.)				
	Woods	9		500 x .30	$ 1,350
	Improvements				0
	Severance Damage				3,250
	Subtotal				$317,620
	Subtotal (R)				$318,000
	Contingencies 25% (R)				80,000
	Acquisition Costs	36	tracts	$1,400	50,000
	Total--Lands and Damages				$448,000
	TOTAL NON-FEDERAL COST				$448,000

TABLE C-4-11 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
09.	Channels				
	Bayou Rigolette				
	(1) Mobilization & Demobilization		L.S.		$ 50,000
	(2) Clear & snag channel	25.74	Mi	$15,000	386,100
	(3) Clear berm & disposal areas	378	Ac	1,200	453,600
	Subtotal				$ 889,700
	Subtotal (R)				$ $890,000
	Contingencies 25% (R)				223,000
	Total--Channels				$1,113,000
15.	Floodgates				
	a. Clear & grub	20	Ac	$ 1,200	$ 24,000
	b. Cofferdam--protective	48,260	CY	2.50	120,650
	c. Cofferdam--floodside	96,340	CY	2.50	240,850
	d. Channel excavation	73,986	CY	1.50	110,279
	e. Levee excavation	41,772	CY	1.50	62,658
	f. Structural excavation	17,252	CY	2.50	43,130
	g. Sand backfill	783	CY	20	15,660
	h. Previous backfill	392	CY	20	7,840
	i. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	j. Structural backfill	2,574	CY	7	18,018
	k. Semi-compacted levee	77,035	CY	3	231,105
	l. Seed & fertilizer	19	Ac	700	13,300
	m. Riprap	1,301	tons	30	39,030
	n. Plastic filter cloth	21,670	SF	0.50	10,835
	o. Dewatering		L.S.		300,000
	p. Concrete				
	(1) Stabilizing slab	265	CY	100	26,500
	(2) Culvert	2,330	CY	300	699,000
	(3) Alinement collars	263	CY	400	105,200
	(4) Inlet & outlet monoliths	770	CY	300	231,000
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	146	CY	500	73,000
	(7) Stoplogs	48	CY	300	14,400

TABLE C-4-11 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	q. Sluice gate	4	Ea.	$30,000	$ 120,000
	r. Machinery platform	3,600	lb.	3	10,800
	s. Walk bridge (precase prestress)	1	ea.		25,000
	t. Handrail	560	LF	25	14,000
	u. Steel sheet pile (pz-27)	1,380	SF	12.50	17,250
	v. Waterstops	1,880	LF	8	15,040
	w. Perforated pipe (6" diameter pvc)	160	LF	25	4,000
	x. Electrical work		L.S.		25,000
	y. Operating equipment		L.S.		225,000
	z. Road maintenance	3	Mi		200,000
	aa. Mobilization & demobilization		L.S.		50,000
	bb. Floodside cofferdam--emergency	39,530	CY	3	118,590
	Subtotal				$3,221,835
	Contingencies (±25%)				808,165
	Total--Floodgates				$4,030,000
	SUMMARY OF FEDERAL COSTS				
09.	Channels				$1,113,000
15.	Floodgates				4,030,000
	Subtotal				$5,143,000
30.	Engineering & Design (±25%) 1/				$1,286,000
	Engineering & Design--Acquisition				3,000
31.	Supervision & Administration (±10%)				510,000
	TOTAL FEDERAL COST				$6,942,000
	TOTAL PROJECT FIRST COST				$7,390,000

1/ Includes pre-construction planning estimate.

TABLE C-4-12

FIRST COST

Plan 9B2
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Cropland	106	Ac	$2,000	$212,000
	(2) Cropland	35	Ac	1,400	49,000
	(3) Woods	175	Ac	500	87,500
	(4) Woods	92	Ac	300	27,600
	(5) Woods	11	Ac	500	5,500
		419			$381,600
	b. Temporary Material Disposal Easement (3 yrs.)				
	(1) Cropland	86		2,000 x .40	$ 68,800
	(2) Cropland	46		1,400 x .40	25,760
	(3) Woods	79		800 x .30	18,960
		211			$113,520
	c. Temporary Construction Easement (3 yrs.)				
	Woods	9		500 x .30	$ 1,350
	Improvements				0
	Severance Damage				3,250
	Subtotal				$499,720
	Subtotal (R)				$500,000
	Contingencies 25% (R)				125,000
	Acquisition Costs	71 tracts		$1,400	99,000
	Total--Lands and Damages				$724,000
	TOTAL NON-FEDERAL COST				$724,000

TABLE C-4-12 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
09.	Channels				
	a. Bayou Rigolette				
	(1) Mobilization & Demobilization		L.S.		$ 50,000
	(2) Clear & snag channel	25.74	Mi	$15,000	386,100
	(3) Clear berm & disposal areas	378	Ac	1,200	453,600
	Subtotal				$ 889,700
	b. Bayou Darrow				
	(1) Mobilization & Demobilization		L.S.		$ 35,000
	(2) Clear & snag channel	7.64	Mi	$15,000	114,600
	(3) Clear berm & disposal areas	112	Ac	1,200	134,400
	Subtotal				$ 284,000
	c. Bayou Marteau				
	(1) Mobilization & Demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	4.0	Mi	$12,000	48,000
	(3) Clear berm & disposal areas	54	Ac	1,200	64,800
	Subtotal				$ 137,800
	d. Bayou Sam				
	(1) Mobilization & Demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	5.0	Mi	$12,000	60,000
	(3) Clear berm & disposal areas	36	Ac	1,200	43,200
	Subtotal				$ 128,200
	e. Bayou Saline				
	(1) Mobilization & Demobilization		L.S.		$ 35,000
	(2) Clear & snag channel	5.5	Mi	$ 8,000	44,000
	(3) Clear berm & disposal areas	39	Ac	1,200	46,800
	Subtotal				$ 125,800
	Subtotal (R)				$1,566,000
	Contingencies 25% (R)				392,000
	Total--Channels				$1,958,000

TABLE C-4-12 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates				
	a. Clear & grub	20	Ac	$ 1,200	$ 24,000
	b. Cofferdam—protective	48,260	CY	2.50	120,650
	c. Cofferdam--floodside	96,340	CY	2.50	240,850
	d. Channel excavation	73,986	CY	1.50	110,279
	e. Levee excavation	41,772	CY	1.50	62,658
	f. Structural excavation	17,252	CY	2.50	43,130
	g. Sand backfill	783	CY	20	15,660
	h. Previous backfill	392	CY	20	7,840
	i. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	j. Structural backfill	2,574	CY	7	18,018
	k. Semi-compacted levee	77,035	CY	3	231,105
	l. Seed & fertilizer	19	Ac	700	13,300
	m. Riprap	1,301	tons	30	39,030
	n. Plastic filter cloth	21,670	SF	0.50	10,835
	o. Dewatering		L.S.		300,000
	p. Concrete				
	(1) Stabilizing slab	265	CY	100	26,500
	(2) Culvert	2,330	CY	300	699,000
	(3) Alinement collars	263	CY	400	105,200
	(4) Inlet & outlet monoliths	770	CY	300	231,000
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	146	CY	500	73,000
	(7) Stoplogs	48	CY	300	14,400
	q. Sluice gate	4	Ea.	30,000	120,000
	r. Machinery platform	3,600	lb.	3	10,800
	s. Walk bridge (precase prestress)	1	ea.		25,000
	t. Handrail	560	LF	25	14,000
	u. Steel sheet pile (pz-27)	1,380	SF	12.50	17,250
	v. Waterstops	1,880	LF	8	15,040
	w. Perforated pipe (6" diameter pvc)	160	LF	25	4,000
	x. Electrical work		L.S.		25,000
	y. Operating equipment		L.S.		225,000
	z. Road maintenance	3	Mi		200,000
	aa. Mobilization & demobilization		L.S.		50,000
	bb. Floodside cofferdam--emergency	39,530	CY	3	118,590
	Subtotal				$3,221,835
	Contingencies (±25%)				808,165
	Total--Floodgates				$4,030,000

TABLE C-4-12 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	SUMMARY OF FEDERAL COSTS				
09.	Channels				$1,958,000
15.	Floodgates				4,030,000
	Subtotal				$5,988,000
30.	Engineering & Design (±25%) 1/				$1,494,000
	Engineering & Design--Acquisition				6,000
31.	Supervision & Administration (±10%)				598,000
	TOTAL FEDERAL COST				$8,086,000
	TOTAL PROJECT FIRST COST				$8,810,000

1/ *Includes pre-construction planning estimate.*

TABLE C-4-13

FIRST COST

Plan 9B3
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Cropland	137	Ac	$2,000	$274,000
	(2) Cropland	35	Ac	1,400	49,000
	(3) Woodland	175	Ac	500	87,500
	(4) Woodland	132	Ac	300	33,900
	(5) Woodland	11	Ac	500	5,500
		471			$449,900
	b. Temporary Material Disposal				
	(1) Cropland	120		$ 800	$ 96,000
	(2) Cropland	46		560	25,760
	(3) Woodland	82		240	19,680
		248			$141,440
	c. Temporary Construction Easement Woodland	9		$ 150	$ 1,350
	Improvements				0
	Severance Damage				3,250
	Subtotal				$595,940
	Subtotal (R)				$596,000
	Contingencies 25% (R)				149,000
	Acquisition Costs	71	tracts	$1,400	127,000
	Total--Lands and Damages				$872,000
	TOTAL NON-FEDERAL COST				$872,000

TABLE C-4-13 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
09.	Channels				
	a. Bayou Rigolette				
	(1) Mobilization & Demobilization		L.S.		$ 50,000
	(2) Clear & snag channel	25.74	Mi	$15,000	386,100
	(3) Clear berm & disposal areas	378	Ac	1,200	453,600
	Subtotal				$ 889,700
	b. Bayou Darrow				
	(1) Mobilization & Demobilization		L.S.		$ 35,000
	(2) Clear & snag channel	7.64	Mi	$15,000	114,600
	(3) Clear berm & disposal areas	112	Ac	1,200	134,400
	Subtotal				$ 284,000
	c. Bayou Marteau				
	(1) Mobilization & Demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	4.0	Mi	$12,000	48,000
	(3) Clear berm & disposal areas	54	Ac	1,200	64,800
	Subtotal				$ 137,800
	d. Bayou Sam				
	(1) Mobilization & Demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	5.0	Mi	$12,000	60,000
	(3) Clear berm & disposal areas	36	Ac	1,200	43,200
	Subtotal				$ 128,200
	e. Bayou Saline				
	(1) Mobilization & Demobilization		L.S.		$ 35,000
	(2) Clear & snag channel	5.5	Mi	$ 8,000	44,000
	(3) Clear berm & disposal areas	39	Ac	1,200	46,800
	Subtotal				$ 125,800
	f. Bayou DuGrappe & Sugarhouse				
	(1) Mobilization & Demobilization		L.S.		$ 25,000
	(2) Clear & snag channel	12.2	Mi	$ 8,000	97,600
	(3) Clear berm & disposal areas	89	Ac	1,200	106,800
	Subtotal				$ 229,400
	Subtotal (R)				$1,794,900
	Contingencies 25% (R)				448,100
	Total--Channels				$2,243,000

TABLE C-4-13 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates				
	a. Clear & grub	20	Ac	$ 1,200	$ 24,000
	b. Cofferdam--protective	48,260	CY	2.50	120,650
	c. Cofferdam--floodside	96,340	CY	2.50	240,850
	d. Channel excavation	73,986	CY	1.50	110,979
	e. Levee excavation	41,772	CY	1.50	62,658
	f. Structural excavation	17,252	CY	2.50	43,130
	g. Sand backfill	783	CY	20	15,660
	h. Previous backfill	392	CY	20	7,840
	i. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	j. Structural backfill	2,574	CY	7	18,018
	k. Semi-compacted levee	77,035	CY	3	231,105
	l. Seed & fertilizer	19	Ac	700	13,300
	m. Riprap	1,301	tons	30	39,030
	n. Plastic filter cloth	21,670	SF	0.50	10,835
	o. Dewatering		L.S.		300,000
	p. Concrete				
	(1) Stabilizing slab	265	CY	100	26,500
	(2) Culvert	2,330	CY	300	699,000
	(3) Alinement collars	263	CY	400	105,200
	(4) Inlet & outlet monoliths	770	CY	300	231,000
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	146	CY	500	73,000
	(7) Stoplogs	48	CY	300	14,400
	q. Sluice gate	4	Ea.	$30,000	$ 120,000
	r. Machinery platform	3,600	lb.	3	10,800
	s. Walk bridge (precase prestress)	1	ea.		25,000
	t. Handrail	560	LF	25	14,000
	u. Steel sheet pile (pz-27)	1,380	SF	12.50	17,250
	v. Waterstops	1,880	LF	8	15,040
	w. Perforated pipe (6" diameter pvc)	160	LF	25	4,000
	x. Electrical work		L.S.		25,000
	y. Operating equipment		L.S.		225,000
	z. Road maintenance	3	Mi		200,000
	aa. Mobilization & demobilization		L.S.		50,000
	bb. Floodside cofferdam--emergency	39,530	CY	3	118,590
	Subtotal				$3,221,835
	Contingencies (±25%)				808,165
	Total--Floodgates				$4,030,000

TABLE C-4-13 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	SUMMARY OF FEDERAL COSTS				
09.	Channels				$2,243,000
15.	Floodgates				4,030,000
	Subtotal				$6,273,000
30.	Engineering & Design (+25%) 1/				$1,570,000
	Engineering & Design--Acquisition				8,000
31.	Supervision & Administration (+10%)				627,000
	TOTAL FEDERAL COST				$8,478,000
	TOTAL PROJECT FIRST COST				$9,350,000

1/ Includes pre-construction planning estimate.

TABLE C-4-14

FIRST COST

Plan 9B4
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Cropland	137	Ac	$2,000	$274,000
	(2) Cropland	35	Ac	1,400	49,000
	(3) Woodland	175	Ac	500	87,500
	(4) Woodland	132	Ac	300	33,900
	(5) Woodland	11	Ac	500	5,500
		471			$449,900
	b. Temporary Material Disposal (3 yrs.)				
	(1) Cropland	59	2,000 x .40		47,200
	(2) Cropland	23	1,400 x .40		12,880
	(3) Woodland	42	800 x .30		10,080
		124			$ 70,160
	c. Temporary Construction Easement (3 yrs.)				
	Woodland	9	500 x .30		$ 1,350
	Improvements				0
	Severance Damage				3,250
	Subtotal				$524,660
	Subtotal (R)				$525,000
	Contingencies 25% (R)				131,000
	Acquisition Costs	91	tracts	$1,400	127,000
	Total--Lands and Damages				$783,000
	TOTAL NON-FEDERAL COST				$783,000

TABLE C-4-14 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
09.	Channels				
	a. Bayou Rigolette				
	Selective clear & snag	25.74	Mi	$11,000	283,100
	b. Bayou Darrow				
	Selective clear & snag	7.64	Mi	$11,000	84,000
	c. Bayou Marteau				
	Selective clear & snag	4.0	Mi	$11,000	44,000
	d. Bayou Sam				
	Selective clear & snag	5.0	Mi	$11,000	55,000
	e. Bayou Saline				
	Selective clear & snag	5.5	Mi	$11,000	60,500
	f. Bayou DuGrappe & Sugarhouse				
	Selective clear & snag	12.2	Mi	$11,000	134,200
	Subtotal (R)				$ 660,800
	Contingencies 25% (R)				165,200
	Total--Channels				$ 826,000

TABLE C-4-14 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates				
	a. Clear & grub	20	Ac	$ 1,200	$ 24,000
	b. Cofferdam--protective	48,260	CY	2.50	120,650
	c. Cofferdam--floodside	96,340	CY	2.50	240,850
	d. Channel excavation	73,986	CY	1.50	110,979
	e. Levee excavation	41,772	CY	1.50	62,658
	f. Structural excavation	17,252	CY	2.50	43,130
	g. Sand backfill	783	CY	20	15,660
	h. Previous backfill	392	CY	20	7,840
	i. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	j. Structural backfill	2,574	CY	7	18,018
	k. Semi-compacted levee	77,035	CY	3	231,105
	l. Seed & fertilizer	19	Ac	700	13,300
	m. Riprap	1,301	tons	30	39,030
	n. Plastic filter cloth	21,670	SF	0.50	10,835
	o. Dewatering		L.S.		300,000
	p. Concrete				
	(1) Stabilizing slab	265	CY	100	26,500
	(2) Culvert	2,330	CY	300	699,000
	(3) Alinement collars	263	CY	400	105,200
	(4) Inlet & outlet monoliths	770	CY	300	231,000
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	146	CY	500	73,000
	(7) Stoplogs	48	CY	300	14,400
	q. Sluice gate	4	Ea.	$30,000	$ 120,000
	r. Machinery platform	3,600	lb.	3	10,800
	s. Walk bridge (precase prestress)	1	ea.		25,000
	t. Handrail	560	LF	25	14,000
	u. Steel sheet pile (pz-27)	1,380	SF	12.50	17,250
	v. Waterstops	1,880	LF	8	15,040
	w. Perforated pipe (6" diameter pvc)	160	LF	25	4,000
	x. Electrical work		L.S.		25,000
	y. Operating equipment		L.S.		225,000
	z. Road maintenance	3	Mi		200,000
	aa. Mobilization & demobilization		L.S.		50,000
	bb. Floodside cofferdam--emergency	39,530	CY	3	118,590
	Subtotal				$3,221,835
	Contingencies (±25%)				808,165
	Total--Floodgates				$4,030,000

TABLE C-4-14 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	SUMMARY OF FEDERAL COSTS				
09.	Channels				$ 826,000
15.	Floodgates				4,030,000
	Subtotal				$4,856,000
30.	Engineering & Design (±25%) 1/				$1,214,000
	Engineering & Design--Acquisition				8,000
31.	Supervision & Administration (±10%)				489,000
	TOTAL FEDERAL COST				$6,567,000
	TOTAL PROJECT FIRST COST				$7,350,000

1/ Includes pre-construction planning estimate.

TABLE C-4-15

FIRST COST

Plan 19A
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Woodland	11	Ac	$ 500	$5,500
	b. Temporary Construction Easement				
	(1) Woodland	9	Ac	$ 150	$1,350
	c. Perpetual "No Development Easement"				
	(1) Woodland	3,178	Ac	$ 500	$1,589,000
	Improvements				0
	Severance Damage				2,250
	Subtotal	3,198			$1,599,100
	Subtotal (R)				$1,599,000
	Contingencies (+25%)				400,000
	Acquisition Cost	32	tracts	$1,400	45,000
	Total--Lands and Damages				$2,044,000
	TOTAL NON-FEDERAL COST				$2,044,000

TABLE C-4-15 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
15.	Floodgates				
	a. Clear & grub	20	Ac	$ 1,200	$ 24,000
	b. Cofferdam--protective	46,875	CY	2.50	117,188
	c. Cofferdam--floodside	93,870	CY	2.50	234,675
	d. Channel excavation	73,986	CY	1.50	110,979
	e. Levee excavation	33,632	CY	1.50	50,448
	f. Structural excavation	13,446	CY	2.50	33,615
	g. Sand backfill	740	CY	20	14,800
	h. Pervious backfill	392	CY	20	7,840
	i. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	j. Structural backfill	2,283	CY	7	15,981
	k. Semi-compacted levee	73,190	CY	3	219,570
	l. Seed & fertilize	19	Ac	700	13,300
	m. Riprap	1,079	tons	30	32,370
	n. Plastic filter cloth	17,270	SF	0.50	8,635
	o. Dewatering		L.S.		300,000
	p. Concrete				
	(1) Stabilizing slab	132	CY	100	13,200
	(2) Culvert	1,260	CY	300	378,000
	(3) Alinement collars	150	CY	400	60,000
	(4) Inlet & outlet monoliths	454	CY	300	136,200
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	80	CY	500	40,000
	(7) Stoplogs	24	CY	300	7,200
	q. Sluice gate	2	Ea.	30,000	60,000
	r. Machinery platform	1,800	lb.	3	5,400
	s. Walk bridge (precast prestress)	1	Ea.		25,000
	t. Handrail	320	LF	25	8,000
	u. Steel sheet pile (pz-27)	690	SF	12.50	8,625
	v. Waterstops	940	LF	8	7,520
	w. Perforated pipe (6" diameter pvc)	135	LF	25	3,375
	x. Electrical work		L.S.		25,000
	y. Operating equipment		L.S.		112,500
	z. Road maintenance	3	Mi		200,000
	aa. Mobilization & demobilization		L.S.		50,000
	bb. Floodside cofferdam--emergency	39,530	CY	3	118,590

TABLE C-4-15 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	Subtotal				$2,452,011
	Contingencies (±25%)				612,989
	Total--Floodgates				$3,065,000
	SUMMARY OF FEDERAL COSTS				
15.	Floodgates				$3,065,000
30.	Engineering & Design (±31)1/				950,000
	Engineering & Design--Acquisition				3,000
31.	Supervision & Administration (±11%)				338,000
	TOTAL FEDERAL COST				$4,356,000
	TOTAL PROJECT FIRST COST				$6,400,000

1/ Includes pre-construction planning estimate.

TABLE C-4-16

FIRST COST

Plan 19B
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Woodland	11	Ac	$ 500	$5,500
	b. Temporary Construction Easement				
	(1) Woodland	9	Ac	$ 150	$1,350
	c. Perpetual "No Development Easement"				
	(1) Woodland	2,180	Ac	$ 500	$1,090,500
	Improvements				0
	Severance Damage				3,250
	Subtotal	2,200			$1,100,600
	Subtotal (R)				$1,101,000
	Contingencies (±25%) (R)				275,000
	Acquisition Cost	22	tracts	$1,400	31,000
	Total--Lands and Damages				$1,407,000
	TOTAL NON-FEDERAL COST				$1,407,000

TABLE C-4-16 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
15.	Floodgates				
	a. Clear & grub	20	Ac	$1,200	$ 24,000
	b. Cofferdam--protective	48,260	CY	2.50	120,650
	c. Cofferdam--floodside	96,340	CY	2.50	240,850
	d. Channel excavation	73,986	CY	1.50	110,979
	e. Levee excavation	41,772	CY	1.50	62,658
	f. Structural excavation	17,252	CY	2.50	43,130
	g. Sand backfill	783	CY	20	15,660
	h. Pervious backfill	392	CY	20	7,840
	i. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	j. Structural backfill	2,574	CY	7	18,018
	k. Semi-compacted levee	77,035	CY	3	231,105
	l. Seed & fertilize	19	Ac	700	13,300
	m. Riprap	1,301	tons	30	39,030
	n. Plastic filter cloth	21,670	SF	0.50	10,835
	o. Dewatering		L.S.		300,000
	p. Concrete				
	(1) Stabilizing slab	265	CY	100	26,500
	(2) Culvert	2,330	CY	300	699,000
	(3) Alinement collars	263	CY	400	105,200
	(4) Inlet & outlet monoliths	770	CY	300	231,000
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	146	CY	500	73,000
	(7) Stoplogs	48	CY	300	14,400
	q. Sluice gate	4	Ea.	30,000	120,000
	r. Machinery platform	3,600	lb.	3	10,800
	s. Walk bridge (precast prestress)	1	Ea.		25,000
	t. Handrail	560	LF	25	14,000
	u. Steel sheet pile (pz-27)	1,380	SF	12.50	17,250
	v. Waterstops	1,880	LF	8	15,040
	w. Perforated pipe (6" diameter pvc)	160	LF	25	4,000
	x. Electrical work		L.S.		25,000
	y. Operating equipment		L.S.		225,000
	z. Road maintenance	3	Mi		200,000
	aa. Mobilization & demobilization		L.S.		50,000
	bb. Floodside cofferdam--emergency	39,530	CY	3	118,590

TABLE C-4-16 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	Subtotal				$3,221,835
	Contingencies (±25%)				808,165
	Total--Floodgates				$4,030,000
	SUMMARY OF FEDERAL COSTS				
15.	Floodgates				$4,030,000
30.	Engineering & Design (±28%)1/				1,117,000
	Engineering & Design--Acquisition				3,000
31.	Supervision & Administration (±11%)				443,000
	TOTAL FEDERAL COST				$5,593,000
	TOTAL PROJECT FIRST COST				$7,000,000

1/ Includes pre-construction planning estimate.

TABLE C-4-17

FIRST COST

Plan 19C
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Woodland	11	Ac	$ 500	$5,500
	b. Temporary Construction Easement				
	(1) Woodland	9	Ac	$ 150	$1,350
	c. Perpetual "No Development Easement"				
	(1) Woodland	1,963	Ac	$ 500	$981,500
	Improvements				0
	Severance Damage				3,250
	Subtotal	1,983			$991,600
	Subtotal (R)				$ 992,000
	Contingencies (+25%)				248,000
	Acquisition Cost	20	tracts	$1,400	28,000
	Total--Lands and Damages				$1,268,000
	TOTAL NON-FEDERAL COST				$1,268,000

TABLE C-4-17 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
15.	Floodgates				
	a. Clear & grub	20	Ac	$ 1,200	$ 24,000
	b. Cofferdam--protective	49,645	CY	2.50	124,113
	c. Cofferdam--floodside	98,810	CY	2.50	247,025
	d. Channel excavation	73,986	CY	1.50	110,979
	e. Levee excavation	49,912	CY	1.50	74,868
	f. Structural excavation	21,057	CY	2.50	52,642
	g. Sand backfill	830	CY	20	16,600
	h. Pervious backfill	392	CY	20	7,840
	i. Gravel (gravel, clay, & sand)	170	CY	20	3,400
	j. Structural backfill	2,866	CY	7	20,062
	k. Semi-compacted levee	81,235	CY	3	243,705
	l. Seed & fertilize	20	Ac	700	14,000
	m. Riprap	1,568	tons	30	47,040
	n. Plastic filter cloth	26,232	SF	0.50	13,116
	o. Dewatering		L.S.		300,000
	p. Concrete				
	(1) Stabilizing slab	397	CY	100	39,700
	(2) Culvert	3,400	CY	300	1,020,000
	(3) Alinement collars	375	CY	400	150,000
	(4) Inlet & outlet monoliths	1,090	CY	300	327,000
	(5) Wing walls	22	CY	300	6,600
	(6) Gate tower	216	CY	500	108,000
	(7) Stoplogs	72	CY	300	21,600
	q. Sluice gate	6	Ea.	30,000	180,000
	r. Machinery platform	7,200	lb.	3	21,600
	s. Walk bridge (precast prestress)	1	Ea.		25,000
	t. Handrail	800	LF	25	20,000
	u. Steel sheet pile (pz-27)	2,070	SF	12.50	25,875
	v. Waterstops	2,820	LF	8	22,560
	w. Perforated pipe (6" diameter pvc)	200	LF	25	5,000
	x. Electrical work		L.S.		25,000
	y. Operating equipment		L.S.		337,500
	z. Road maintenance	3	Mi		200,000
	aa. Mobilization & demobilization		L.S.		50,000
	bb. Floodside cofferdam--emergency	39,530	CY	3	118,590

TABLE C-4-17 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
15.	Floodgates (Continued)				
	Subtotal				$4,003,415
	Contingencies (±25%)				996,585
	Total--Floodgates				$5,000,000
	SUMMARY OF FEDERAL COSTS				
15.	Floodgates				$5,000,000
30.	Engineering & Design (±25%)1/				1,279,000
	Engineering & Design--Acquisition				3,000
31.	Supervision & Administration (±11%)				550,000
	TOTAL FEDERAL COST				$6,832,000
	TOTAL PROJECT FIRST COST				$8,100,000

1/ Includes pre-construction planning estimate.

TABLE C-4-18

FIRST COST

Plan 20A
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Woodland	8	Ac	$500	$4,000
	b. Temporary Construction Easement				
	(1) Woodland	10	Ac	$150	$1,500
	Improvements				0
	Severance Damage				1,000
	Subtotal				$6,500
	Subtotal (R)	18			$ 7,000
	Contingencies (±25%)				2,000
	Acquisition Cost				1,000
	Total--Lands and Damages				$10,000
	TOTAL NON-FEDERAL COST				$10,000

TABLE C-4-18 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
13.	Pumping Plant				
	a. Mobilization & demobilization		L.S.		$ 125,000
	b. Clear & grub		L.S.		65,000
	c. Channel excavation	113,500	CY	$1.50	170,250
	d. Structural excavation	102,000	CY	2.50	255,000
	e. Pile load test		L.S.		35,000
	f. Structural backfill	8,500	CY	7	59,500
	g. Steel H-piling	22,200	LF	28	621,600
	h. Well drain system		L.S.		60,000
	i. Cofferdam	43,000	CY	3	129,000
	j. Rock dike--riprap	85,000	tons	25	2,125,000
	k. Pumping station--structure		L.S.		8,900,000
	l. Pumping station--machinery		L.S.		2,200,000
	m. Inside crane		L.S.		130,000
	n. Riprap protection	10,800	tons	25	270,000
	o. Bedding material		L.S.		60,000
	p. Fencing		L.S.		8,000
	q. Turfing/Seeding		L.S.		7,000
	r. Haul road maintenance	3	Mi		200,000
	s. Environmental protection		L.S.		20,000
	Subtotal				$15,440,350
	Contingencies (±25%)				3,859,650
	Total--Pumping Plant				$19,300,000
	SUMMARY OF FEDERAL COSTS				
13.	Pumping Plant				$19,300,000
30.	Engineering & Design (±17%)1/				3,289,000
	Engineering & Design--Acquisition				1,000
31.	Supervision & Administration (±11%)				2,100,000
	TOTAL FEDERAL COST				$24,690,000
	TOTAL PROJECT FIRST COST				$24,700,000

1/ Includes pre-construction planning estimate.

TABLE C-4-19

FIRST COST

Plan 20B
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Woodland	8	Ac	$500	$4,000
	b. Temporary Construction Easement				
	(1) Woodland	10	Ac	$150	$1,500
	Improvements				0
	Severance Damage				1,000
	Subtotal	18			$6,500
	Subtotal (R)				$ 7,000
	Contingencies (+25%)				2,000
	Acquisition Cost				1,000
	Total--Lands and Damages				$10,000
	TOTAL NON-FEDERAL COST				$10,000

TABLE C-4-19 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
13.	Pumping Plant				
	a. Mobilization & demobilization		L.S.		$ 125,000
	b. Clear & grub		L.S.		75,000
	c. Channel excavation	113,500	CY	$1.50	170,250
	d. Structural excavation	120,000	CY	2.50	300,000
	e. Pile load test		L.S.		35,000
	f. Structural backfill	12,000	CY	7	84,000
	g. Steel H-piling	30,000	LF	28	840,000
	h. Well drain system		L.S.		60,000
	i. Cofferdam	43,000	CY	3	129,000
	j. Rock dike--riprap	85,000	tons	25	2,125,000
	k. Pumping station--structure		L.S.		13,600,000
	l. Pumping station--machinery		L.S.		4,400,000
	m. Inside crane		L.S.		150,000
	n. Riprap protection	16,200	tons	25	405,000
	o. Bedding material		L.S.		70,000
	p. Fencing		L.S.		10,000
	q. Turfing/Seeding		L.S.		7,000
	r. Haul road maintenance	3	Mi		200,000
	s. Environmental protection		L.S.		20,000
	Subtotal				$22,805,250
	Contingencies (+25%)				5,694,750
	Total--Pumping Plant				$28,500,000
	SUMMARY OF FEDERAL COSTS				
13.	Pumping Plant				$28,500,000
30.	Engineering & Design (+16%)[1/]				4,589,000
	Engineering & Design--Acquisition				1,000
31.	Supervision & Administration (+8%)				2,300,000
	TOTAL FEDERAL COST				$35,390,000
	TOTAL PROJECT FIRST COST				$35,400,000

1/ Includes pre-construction planning estimate.

TABLE C-4-20

FIRST COST

Plan 20C
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	NON-FEDERAL				
01.	Lands and Damages				
	a. Perpetual Channel Easement				
	(1) Woodland	8	Ac	$500	$4,000
	b. Temporary Construction Easement				
	(1) Woodland	10	Ac	$150	$1,500
	Improvements				0
	Severance Damage				1,000
	Subtotal	18			$6,500
	Subtotal (R)				$ 7,000
	Contingencies (±25%)				2,000
	Acquisition Cost				1,000
	Total--Lands and Damages				$10,000
	TOTAL NON-FEDERAL COST				$10,000

TABLE C-4-20 (CONTINUED)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
	FEDERAL				
13.	Pumping Plant				
	a. Mobilization & demobilization		L.S.		$ 125,000
	b. Clear & grub		L.S.		85,000
	c. Channel excavation	113,500	CY	$1.50	170,250
	d. Structural excavation	123,000	CY	2.50	307,500
	e. Pile load test		L.S.		35,000
	f. Structural backfill	16,200	CY	7	113,400
	g. Steel H-piling	44,900	LF	28	1,257,200
	h. Well drain system		L.S.		80,000
	i. Cofferdam	43,000	CY	3	129,000
	j. Rock dike--riprap	85,000	tons	25	2,125,000
	k. Pumping station--structure		L.S.		20,243,055
	l. Pumping station--machinery		L.S.		6,500,000
	m. Inside crane		L.S.		150,000
	n. Riprap protection	21,600	tons	25	540,000
	o. Bedding material		L.S.		80,000
	p. Fencing		L.S.		12,000
	q. Turfing/Seeding		L.S.		7,000
	r. Haul road maintenance	3	Mi		200,000
	s. Environmental protection		L.S.		20,000
	Subtotal				$32,179,405
	Contingencies (+25%)				8,020,595
	Total--Pumping Plant				$40,200,000
	SUMMARY OF FEDERAL COSTS				
13.	Pumping Plant				$40,200,000
30.	Engineering & Design (+15%)1/				5,989,000
	Engineering & Design--Acquisition				1,000
31.	Supervision & Administration (+8%)				3,200,000
	TOTAL FEDERAL COST				$43,390,000
	TOTAL PROJECT FIRST COST				$49,400,000

1/ Includes pre-construction planning estimate.

TABLE C-4-21

SUMMARY OF PROJECT FIRST COSTS
($000)

ITEMS	PLAN 3			PLAN 5				PLAN 6			
	3A	3B	3C	5A	5B	5C	5D	6A	6B	6C	6D
Non-Federal											
Relocations	-	$2,131	$2,131	-	-	-	-	-	-	-	-
Lands & Damages	$859	1,363	1,498	$13	$13	$13	$13	$481	$425	$365	$365
TOTAL NON-FEDERAL COST	859	3,494	3,629	13	13	13	13	481	425	365	365
FEDERAL											
Earthern Closures	-	-	-	-	-	-	-	212	212	212	212
Channels	2,243	5,558	7,389	-	-	-	-	3,653	2,368	1,612	1,612
Floodgates	-	-	-	3,100	4,030	5,000	5,900	4,600	5,400	5,800	6,540
Pumping Plants	-	-	-	-	-	-	-	-	-	-	-
Subtotal	2,243	5,558	7,389	3,100	4,030	5,000	5,900	8,465	7,980	7,624	8,364
E&D	428	776	972	965	1,133	1,250	1,475	1,799	1,800	1,934	2,126
E&D-Acquisition	8	9	9	1	1	1	1	5	5	5	5
Super & Admin	182	443	601	341	443	556	651	850	790	772	840
TOTAL FEDERAL COST	2,861	6,786	8,971	4,407	5,607	6,807	8,027	11,119	10,575	10,335	11,335
TOTAL PROJECT FIRST COST	$3,720	$10,280	$12,600	$4,420	$5,620	$6,820	$8,040	$11,600	$11,000	$10,700	$11,700

TABLE C-4-21 (Continued)

SUMMARY OF PROJECT FIRST COSTS
($000)

ITEMS	PLAN 9 9B1	PLAN 9 9B2	PLAN 9 9B3	PLAN 9 9B4	PLAN 19 19A	PLAN 19 19B	PLAN 19 19C	PLAN 20 20A	PLAN 20 20B	PLAN 20 20C
Non-Federal										
Relocations	$448	$724	$872	$783	$2,044	$1,407	$1,268	$10	$10	$10
Lands & Damages	-	-	-	-	-	-	-	-	-	-
TOTAL NON-FEDERAL COST	448	724	872	783	2,044	1,407	1,268	10	10	10
FEDERAL										
Earthern Closures	-	-	-	-	-	-	-	-	-	-
Channels	1,113	1,958	2,243	826	-	-	-	-	-	-
Floodgates	4,030	4,030	4,030	4,030	3,065	4,030	5,000	-	-	-
Pumping Plants	-	-	-	-	-	-	-	19,300	28,500	40,2[illegible]
Subtotal	5,143	5,988	6,273	4,856	3,065	4,030	5,000	19,300	28,500	40,200
E&D	1,286	1,494	1,570	1,214	950	1,117	1,279	3,289	4,589	5,989
E&D-Acquisition	3	6	8	8	3	3	3	1	1	1
Super & Admin	510	598	627	489	338	443	550	2,100	2,30[illegible]	3,200
TOTAL FEDERAL COST	6,942	8,086	8,478	6,567	4,356	5,593	6,832	24,690	35,39[illegible]	49,39[illegible]
TOTAL PROJECT FIRST COST	$7,390	$8,810	$9,350	$7,350	$6,400	$ 7,000	$ 8,100	$24,7[illegible]	$35,90[illegible]	$49,4[illegible]

PLAN	O & M	PLAN	O & M
3B	$80,000	9B2	$ 73,000
5A	6,000	9B3	88,000
5B	13,000	9B4	35,000
5C	19,000	19A	6,000
5D	25,000	19B	13,000
6A	39,000	19C	19,000
6B	48,000	20B	789,000
6C	51,000		
6D	57,000		
9B1	45,000		

MITIGATION

C.4.11. Mitigation was considered in terms of costs and benefits during the detailed plan analysis. Three plans, 5, 6, and 19 were included in the analysis. All three plans lower flood stages on wooded areas and reduce the fish spawning areas. Plan 6 in addition would result in significant adverse impacts on riparian land associated with the channel improvement features of the plans. The preferred mitigation for options 5A through 5D and 19A through 19C consists of acquiring seasonal flowage easement on about 70 acres of agricultural land and 100 acres of wooded. The preferred mitigation for options 6A, 6B, and 6C consists of the purchase in fee and reforestation of about 705 acres of agricultural lands and the acquisition of a flowage easement on about 100 acres of woodland. All of these areas are subject to flooding with the drawdown of Iatt Lake. Total acreage required with options of Plans 5, 6, and 19 are shown in the following listing:

MITIGATION ACREAGE REQUIREMENTS

Plan Option	Purchase Agriculturals Land (Ac)	Easement Acquired (Ac) Agricultural	Woodland
5A through 5D	0	70	100
6A	705	-	100
6B	645	-	100
6C	615	-	100
6D	615	-	100
19A through 19C	0	70	100

Estimates based on January 1985 price levels are presented in Tables C-4-22 through C-4-25.

TABLE C-4-22

FIRST COST

Mitigation for Plans 5A through 5D and 19A through 19C
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
a.	Land and Damages				
	Seasonal Flowage Easement				
	Perpetual*				
	Cropland	70	Ac	$1,800 x .40	50,400
	Woodland	100	Ac	400 x .20	8,000
b.	Improvements				0
c.	Severance Damage				0
	Subtotal (R)				$ 58,000
d.	Contingencies 25% (R)				15,000
e.	Acquisition Costs (Estimated 3 tracts)				
	(1) Non-Federal				$ 4,000
	(2) Federal				1,000
f.	PL-91-646				0
	TOTAL ESTIMATED REAL ESTATE COST				$ 78,000
	TOTAL COST OF ENVIRONMENTAL MEASURE FOR PLANS 5A THROUGH 5D AND 19A THROUGH 19C (ROUNDED)				$ 80,000
	Annual Operation & Maintenance				$ 10,000

* Easement only controls water level between 1 November and 1 March. No restrictions on timber harvest. No development would be allowed.

TABLE C-4-23

FIRST COST

Mitigation for Plan 6A
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
01.	Lands and Damages				
	a. Fee Acquisition				
	Cropland	705	Ac	$1,800	$1,269,000
	b. Seasonal Flowage Easement				
	Perpetual*				
	Woodland	100	Ac	400 x .65	26,000
	c. Improvements				0
	d. Severance Damage				0
	Subtotal (R)				$1,295,000
	e. Contingencies 25% (R)				324,000
	f. Acquisition Costs (Estimated 3 tracts)				
	(1) Non-Federal	3 @ $1,400 per tract			4,000
	(2) Federal				1,000
	g. PL-91-646				0
	TOTAL ESTIMATED REAL ESTATE COST				$1,624,000
06.	Reforistation				$ 100,000
	TOTAL MITIGATION COST FOR PLAN 6A (Rounded)				$1,720,000
	Annual Operation & Maintenance				$ 10,000

* Easement only controls water level between 1 November and 1 March. This estate allows the landowner the right to harvest trees only after a plan is approved by the U.S. Fish and Wildlife Service. No development would be allowed.

TABLE C-4-24

FIRST COST

Mitigation for Plan 6B
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
01.	Lands and Damages				
	a. Fee Acquisition				
	Cropland	645	Ac	$1,800	$1,161,000
	b. Seasonal Flowage Easement				
	Perpetual*				
	Woodland	100	Ac	400 x .65	26,000
	c. Improvements				0
	d. Severance Damage				0
	Subtotal (R)				$1,187,000
	e. Contingencies 25% (R)				297,000
	f. Acquisition Costs (Estimated 2 tracts)				
	(1) Non-Federal	2 @ $1,400 per tract			3,000
	(2) Federal				1,000
	g. PL-91-646				0
	TOTAL ESTIMATED REAL ESTATE COST				$1,488,000
06.	Reforestation				$ 90,000
	TOTAL MITIGATION COST FOR PLAN 6B (ROUNDED)				$1,580,000
	Annual Operation & Maintenance				$ 10,000

* Easement only controls water level between 1 November and 1 March. This allows the landowner the right to harvest trees only after a plan is approved by the U.S. Fish and Wildlife Service. No development would be allowed.

TABLE C-4-25

FIRST COST

Mitigation for Plan 6C and 6D
(1985 Price Levels)

Item No.	Item	Estimated Quantity	Unit	Unit Price	Estimated Cost
01.	Lands and Damages				
	a. Fee Acquisition				
	Cropland	615	Ac	$1,800	$1,107,000
	b. Seasonal Flowage Easement				
	Perpetual*				
	Woodland	70	Ac	400 x .65	26,000
	c. Improvements				0
	d. Severance Damage				0
	Subtotal (R)				$1,133,000
	e. Contingencies 25% (R)				283,000
	f. Acquisition Costs (Estimated 2 tracts)				
	(1) Non-Federal	2 @ $1,400 per tract			3,000
	(2) Federal				1,000
	g. PL-91-646				0
	TOTAL ESTIMATED REAL ESTATE COST				$1,420,000
06.	Reforestation				$ 80,000
	TOTAL MITIGATION COST FOR PLAN 6C AND 6D (ROUNDED)				$1,500,000
	Annual Operation & Maintenance				$ 10,000

* Easement only controls water level between 1 November and 1 March. This estate allows the landowners the right to harvest trees only after a plan is approved by the U.S. Fish and Wildlife Service. No development would be allowed.

SECTION 5. DETAILED HYDROLOGIC AND HYDRAULIC ANALYSES OF TENTATIVELY SELECTED PLAN

GENERAL

C.5.1. Plans 5, 6, and 19 were selected for detailed study. Three options were considered for each plan except Plan 5, which required four options (see Appendix A, Plan Formulation). Plan 5C was designated the tentatively selected plan. This plan involves the installation of six additional 10- by 10-foot floodgates near the two existing 10- by 10-foot floodgates on Bayou Rigolette (see Plate C-25).

DESIGN OBJECTIVES FOR TENTATIVELY SELECTED PLAN

C.5.2. The design objectives for the six additional floodgates to be placed near the Bayou Rigolette structure are:

o Provide the maximum stage lowerings that can be economically justified.

o Function in concert with the existing structure to reduce flood levels and minimize the duration of flooding.

DRAINAGE STRUCTURE CONFIGURATION

C.5.3. The additional outlet structure would consist of an inflow channel, a flared inlet/outlet, six 10- by 10-foot concrete culverts each 210 feet long, an operating tower with six gates, a stilling basin, and an outlet channel (see Plate C-31). The structure was sized to accomplish objectives stated above. The structure was rated based on headwater control employing the orifice flow equation. Plate C-32 shows the structure's rating. Pertinent data for the 3-year, 5-year, and 100-year events are given below:

	3-year	5-year	100-year
Peak Flow (CFS)	4,400	5,800	11,400
Floodgate Area (ft^2)	800	800	800
Velocity (Ft/Sec)	5.50	7.25	14.25
Headwater Elev (Ft. NGVD)	70.90	71.40	74.60
Tailwater Elev (Ft. NGVD)	70.30	70.40	70.70
Head on Structure (Ft)	0.60	1.00	3.90

The riprap protection shown on Plate C-31 was designed to protect the structure against the 100-year frequency storm which would produce maximum approach velocities of 14 ft/sec.

HEC-1 ANALYSIS

C.5.4. Hypothetical storms with frequencies of occurrence from 1 year to 100 years and durations of 24 hours were developed for the 417-square-mile drainage basin using data obtained from the U.S. Weather Bureau Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," published in 1961. Table C-1-3 shows the hourly rainfall in inches for the 24-hour duration storms. In addition, the 96-hour Standard Project Storm (SPS) was developed for use in analyzing the study basin, using the procedures outlined in EM 1110-2-1411, "Standard Project Flood Determinations." For this study, the SPS was assumed to have a return interval of once in 1,000 years. The procedure used to compute flows in the study basin for the selected frequency storms involved calibration of a HEC-1 model. The program is capable of performing five major types of flood hydrograph analyses. The HEC-1 model was used to compute the existing condition discharges for the eight subareas and seven reaches that compose the basin. These discharges were used in the HEC-2 model for computing the water surface profiles. Following the calibration of the study basin HEC-1 model for existing conditions, the model was used to represent the various proposed alternatives including four options under Plan 5. In addition to the tentatively selected plan, Plan 5C, (six additional 10- by 10-foot floodgates), Plan 5A (two additional 10- by 10-foot floodgates), Plan 5B

(four additional 10- by 10-foot floodgates), and Plan 5D (eight additional 10- by 10-foot floodgates) were also studied in order to determine the required number of additional floodgates. Tables C-5-1 provides the simulated discharges for the basin reaches for existing conditions.

INFILTRATION AND RUNOFF

C.5.5. Very little observed data are available for the basin from which runoff factors or infiltration rates may be defined. However, the HEC-1 program option OPTIM was used with nine historical storms to determine the initial (STRTL) and constant (CNSTL) loss rates for each of the eight basin subareas. The resulting values were adjusted for each particular subarea to reflect hydrologic characteristics such as vegetation, local growing

TABLE C-5-1

COMPUTED DISCHARGES

Aloha-Rigolette Area

Routing Reach	Bayou Rigolette Mile	Storm							
		1-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	SPS
1	0	2,605	4,080	4,230	4,480	7,890	9,780	11,680	21,690
2	4.2	2,615	4,090	4,650	6,410	8,260	9,960	11,330	19,780
3	6.7	2,040	2,790	3,510	4,480	5,490	6,040	7,410	14,180
4	8.6	1,940	1,990	2,415	2,900	3,420	4,145	4,760	9,650
5	11.0	1,310	1,825	2,140	2,520	2,925	3,490	3,880	9,605
6	20.0	1,160	1,540	1,760	2,130	2,700	3,110	3,540	9,030
7	23.3	880	1,450	1,730	2,140	2,700	3,110	3,540	6,970
Iatt Lake Dam	25.7								

seasons, soil type, and overland runoff distances. The values used for STRTL and CNSTL for existing conditions and the various alternative plans including the tentatively selected plan are summarized in Table C-5-2.

SYNTHETIC RUNOFF COMPUTATIONS

C.5.6. Runoff hydrographs were generated for each subarea from the HEC-1 model for each of the frequency storms studied. As previously discussed, a 3-hour unit hydrograph for the Lake Iatt subarea (238 square miles) was obtained from the "Definite Project Report for Aloha-Rigolette Area - Grant and Rapides Parishes, Louisiana." The 3-hour unit hydrographs for the remaining subareas were developed using nine hydrograph coordinates through successive approximations. Table C-5-3 provides the values used for generating the runoff and unit hydrographs for the basin subareas.

PROJECT STAGES

C.5.7. As previously discussed, HEC-2 backwater runs were done using a coincident-frequency analysis. Starting water surface elevations input to the HEC-2 model were based on the stage frequency curves that resulted from the coincident-frequency analysis methods provided in EC-1110-2-247. Stage-duration curves for Red River at the mouth of Bayou Rigolette are shown in Plate C-4. Discharge rating curves for the Red River at Alexandria for with and without the Red River Waterway Project are shown in Plate C-33.

FLOOD ROUTINGS

C.5.8. Discharges for each of the frequency storms studied were determined by routing runoffs for each storm through the proposed additional and existing floodgates and through the cleared and snagged channels. Pertinent data resulting from routings for the 3-year and 5-year events are shown in Table C-5-4, also for a tailwater elevation of 70 feet NGVD.

AD A160 791 ALOHA - RIGOLETTE AREA LOUISIANA AGRICULTURAL FLOOD CONTROL VOLUME 2 TECHNICAL APPENDIXES A B C D E(U) ARMY ENGINEER DISTRICT NEW ORLEANS LA JUN 85

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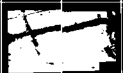


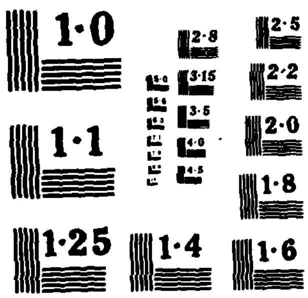

1·0
2·8
2·5
3·15
2·2
3·5
2·0
4·0
4·5
1·1
1·8
1·25
1·4
1·6

TABLE C-5-2

LOSS RATE PARAMETERS

Aloha-Rigolette Area

Subarea	Loss Rate Parameter	Storm							
		1-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	SPS
A	STRTL 1/	1.14	1.20	1.25	1.32	1.40	1.45	1.50	1.71
	CNSTL 2/	0.096	0.101	0.107	0.114	0.121	0.125	0.128	0.137
B	STRTL	1.14	1.20	1.25	1.32	1.40	1.45	1.50	1.71
	CNSTL	0.096	0.101	0.107	0.114	0.121	0.125	0.128	0.137
C	STRTL	1.75	1.84	1.93	2.03	2.16	2.23	2.30	2.63
	CNSTL	0.148	0.156	0.164	0.176	0.186	0.192	0.197	0.210
D	STRTL	2.50	2.63	2.75	2.90	3.08	3.19	3.28	3.75
	CNSTL	0.180	0.190	0.200	0.214	0.226	0.233	0.240	0.260
E	STRTL	2.50	2.63	2.75	2.90	3.08	3.19	3.28	3.75
	CNSTL	0.180	0.190	0.200	0.214	0.226	0.233	0.240	0.260
F	STRTL	1.75	1.84	1.93	2.03	2.16	2.23	2.30	2.63
	CNSTL	0.148	0.156	0.164	0.176	0.186	0.192	0.197	0.210
G	STRTL	2.50	2.63	2.75	2.90	3.08	3.19	3.28	3.75
	CNSTL	0.180	0.190	0.200	0.214	0.226	0.233	0.240	0.260
H	STRTL	2.50	2.63	2.75	2.90	3.08	3.19	3.28	3.75
	CNSTL	0.180	0.190	0.200	0.214	0.226	0.233	0.240	0.260

1/ STRTL = Initial Loss (inches)

2/ CNSTL = Uniform Loss (inches/hour)

TABLE C-5-3

RUNOFF AND UNIT HYDROGRAPH PARAMETERS

	Subareas							
	A	B	C	D	E	F	G	H
Drainage Area (sq. mi.)	238.00	31.30	28.18	14.33	35.52	49.16	9.12	11.39
HEC-1 Base Flow Values								
QRCSN (cfs)	210	0 1/	0	0	0	0	0	0
RTIOR	1.10	0	0	0	0	0	0	0
STRTQ (cfs)	20	0	0	0	0	0	0	0
Unit Hydrograph Parameters								
TC (hrs)	162	72	45	42	72	57	54	60
R (hrs)	150	50	36	14	15	19	22	16
Peak Q (cfs)	560	358	490	280	640	853	197	168

1/ Estimation of base flow is generally arbitrary and is usually a small percentage of total runoff. Accordingly, since good base flow data was not available for subareas B - H, it was taken as negligible.

TABLE C-5-4

ROUTING DATA

3- and 5-Year Storms

Bayou Rigolette - Proposed Improvements (Total - Eight 10' x 10' Floodgates)		
Storm Frequency	3	5
Drainage Area, square miles	417	417
Rainfall, inches	5.55	6.40
Runoff, inches	2.49	3.11
Maximum Inflow, cfs	4,430	5,810
Maximum Outflow, cfs	4,400	5,775
Headwater Stage at Structure, ft. NGVD	69.2	71.2
Tailwater Stage at Structure, ft. NGVD	68.5	70.0
Head on Structure, ft.	0.70	1.2
Maximum Structure Velocity, fps	5.5	7.2

HYDRAULIC COMPUTATIONS

C.5.9. Water surface profiles for the study basin were computed using the HEC-2 program. The HEC-2 program computes the profiles using standard-step backwater computations on data such as cross sections, discharges, and starting water surface elevations. Tables C-5-5 and C-5-6 provide pertinent hydraulic data for Bayou Rigolette for the 3-year and 5-year storm events for both existing conditions and the tentatively selected plan.

LEVEL OF PROTECTION MATRIX

C.5.10. In addition to the tentatively selected plan where six additional 10- by 10-foot floodgates (Plan 5C) would be installed near the existing Bayou Rigolette floodgates, three other options were investigated under Plan 5. Under Plans 5A, 5B, and 5D, the installation of two, four, and eight 10- by 10-foot floodgates, respectively, near the existing Bayou Rigolette structure was studied. Table C-5-7 provides a level of protection matrix detailing the flood stage reductions for each plan at the Pineville and Colfax gages. Under Plans 6A, 6B, 6C, and 6D the installation of four, five, six, and seven 10- by 10-foot floodgates, respectively, would be at the site of the Bayou Darrow closure and the Red River. The four plans also include various amounts of channel enlargement and clearing and snagging. Table C-5-8 provides a level of protection matrix detailing flood stage reductions for each plan at Pineville and Colfax gages. Existing conditions and all the alternative plans were studied using annual frequency stages. However, a partial duration analysis was also conducted on existing conditions since the majority of damages in the basin are to agricultural areas. The partial duration series were also estimated for the tentatively selected plan. Plates C-34 and C-35 show the stage-frequency curves at the Pineville and Colfax gages, respectively, for both existing conditions and the tentatively selected plan in the annual and partial duration series.

TABLE C-5-5

EXISTING CONDITIONS

Aloha-Rigolette Area

Reach	Mile	Existing Discharge (cfs) 3-yr	Existing Discharge (cfs) 5-yr	Average Bottom Width (ft.)	Average Side Slopes	Average Depth (ft.) 3-yr	Average Depth (ft.) 5-yr	Average Velocity (fps) 3-yr	Average Velocity (fps) 5-yr
1	0								
		4,080	4,230	50	1 on 3	21.8	23.8	1.0	0.8
2	4.2								
		4,090	4,650	35	1 on 3	21.5	23.0	1.3	1.3
3	6.7								
		2,790	3,510	25	1 on 3	18.5	20.0	1.5	1.5
4	8.6								
		1,990	2,415	20	1 on 3	17.6	19.1	2.4	2.4
5	11.0								
		1,825	2,140	60	1 on 3	18.6	19.9	1.0	1.1
6	20.0								
		1,540	1,760	80	1 on 3	21.6	23.0	0.6	0.6
7	23.3								
		1,450	1,730	70	1 on 3	16.1	17.5	0.4	0.4
Iatt Lake Dam	25.7								

TABLE C-5-6

TENTATIVELY SELECTED PLAN CONDITIONS

Aloha-Rigolette Area

Reach	Mile	Improved Conditions Discharge (cfs) 3-yr	Improved Conditions Discharge (cfs) 5-yr	Average Bottom Width (ft.)	Average Side Slopes	Average Depth (ft.) 3-yr	Average Depth (ft.) 5-yr	Average Velocity (fps) 3-yr	Average Velocity (fps) 5-yr
1	0								
		4,080	4,230	50	1 on 3	16.2	17.8	1.7	1.5
2	4.2								
		4,090	4,650	35	1 on 3	18.7	19.8	1.7	1.8
3	6.7								
		2,790	3,510	25	1 on 3	16.3	17.5	2.0	2.1
4	8.6								
		1,990	2,415	20	1 on 3	16.8	18.0	2.6	2.7
5	11.0								
		1,825	2,140	60	1 on 3	18.3	19.5	1.1	1.1
6	20.0								
		1,540	1,760	80	1 on 3	21.4	22.7	0.6	0.6
7	23.3								
		1,450	1,730	70	1 on 3	15.9	17.2	0.4	0.4
Iatt Lake Dam	25.7								

TABLE C-5-7

LEVEL OF PROTECTION MATRIX

Aloha-Rigolette Area

Flow Frequency (years)	Plan 5A		Plan 5B		Plan 5C 1/		Plan 5D	
	Flood Elevation (ft. NGVD)	Stage Reduction (ft.)	Flood Elevation (ft. NGVD)	Stage Reduction (ft.)	Flood Elevation (ft. NGVD)	Stage Reduction (ft.)	Flood Elevation (ft. NGVD)	Stage Reduction (ft.)
Pineville Gage								
1	68.5	0.9	68.2	1.2	68.1	1.3	68.0	1.4
3	71.9	4.1	71.1	4.9	70.7	5.3	70.2	5.8
5	74.8	3.2	72.7	5.3	72.1	5.9	71.5	6.5
10	78.0	1.7	76.6	3.1	75.8	3.9	75.4	4.3
25	81.0	0.5	80.4	1.1	79.8	1.7	79.5	2.0
50	82.1	0.3	81.2	1.2	81.3	1.1	80.8	1.6
100	83.0	0.2	82.5	0.7	82.0	1.2	81.6	1.6
SPS	85.0	0.2	84.6	0.6	84.2	1.0	84.0	1.2
Colfax Gage								
1	81.6	0.6	81.6	0.6	81.6	0.6	81.6	0.6
3	85.4	0.4	85.4	0.4	85.4	0.4	85.4	0.4
5	86.3	0.3	86.9	0.3	86.9	0.3	86.9	0.3
10	88.6	0.1	88.6	0.2	88.6	0.2	88.6	0.2
25	90.4	0	90.4	0	90.4	0	90.4	0
50	91.5	0	91.5	0	91.5	0	91.5	0
100	92.6	0	92.6	0	92.6	0	92.6	0
SPS	98.3	0	98.3	0	98.3	0	98.3	0

1/ Tentatively Selected Plan.

TABLE C-5-8

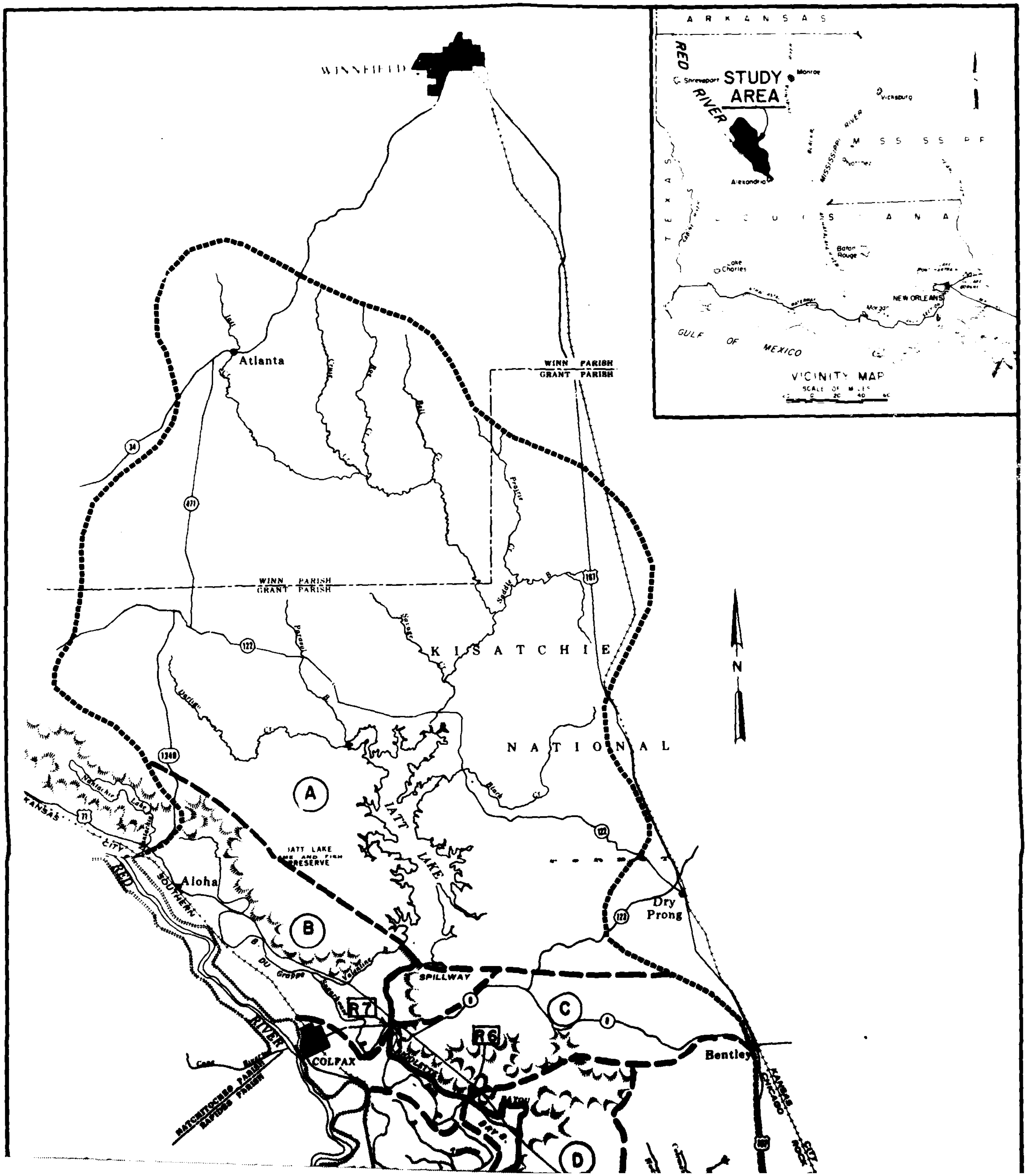
LEVEL OF PROTECTION MATRIX

Aloha-Rigolette Area

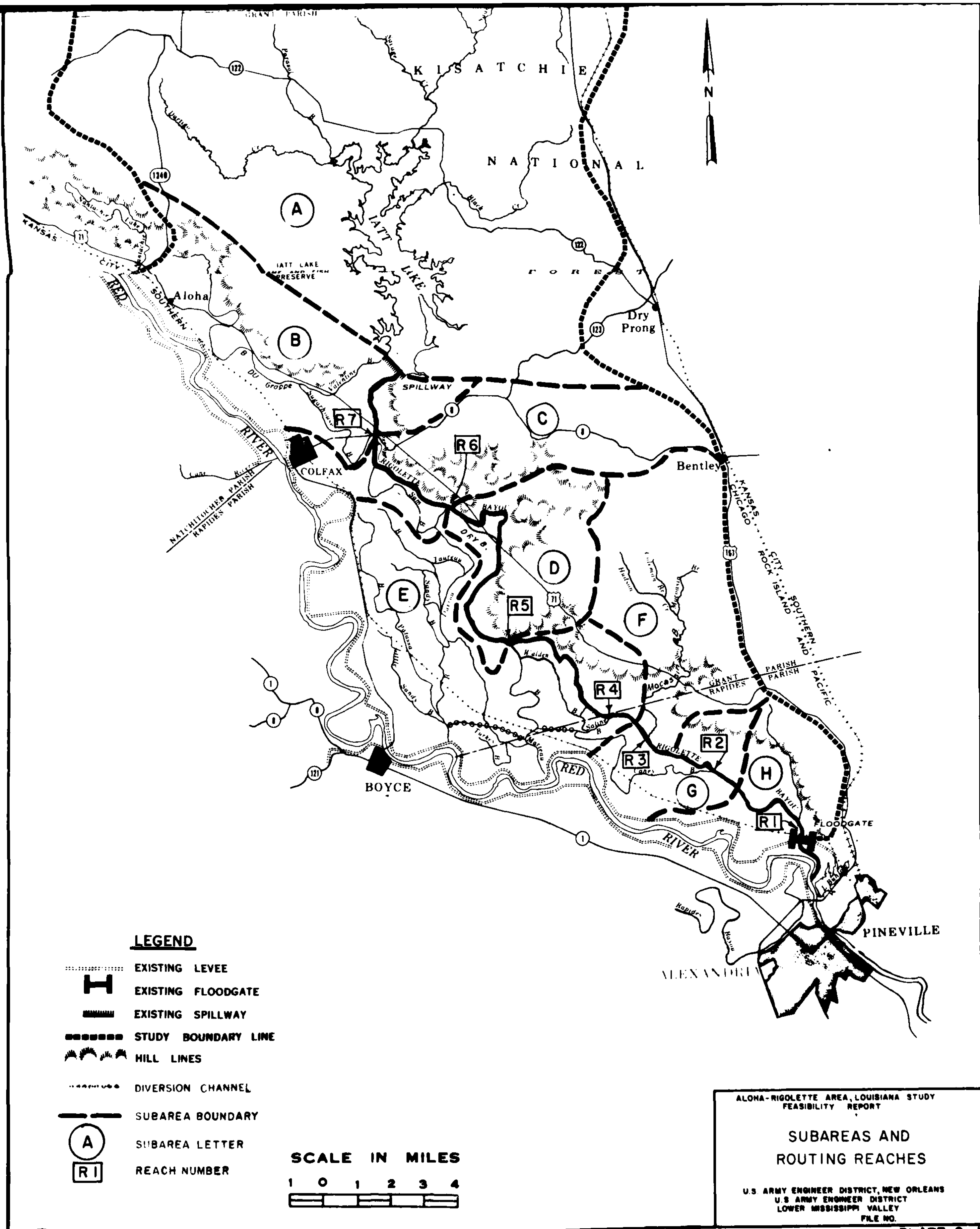
Flow Frequency (years)	Plan 6A Flood Elevation (ft. NGVD)	Plan 6A Stage Reduction (ft.)	Plan 6B Flood Elevation (ft. NGVD)	Plan 6B Stage Reduction (ft.)	Plan 6C Flood Elevation (ft. NGVD)	Plan 6C Stage Reduction (ft.)	Plan 6D Flood Elevation (ft. NGVD)	Plan 6D Stage Reduction (ft.)
Pineville Gage								
1	66.8	2.6	66.8	2.6	66.8	2.6	66.8	2.6
3	69.3	6.7	69.3	6.7	69.3	6.7	69.3	6.7
5	70.6	7.4	70.6	7.4	70.6	7.4	70.6	7.4
10	72.4	7.3	72.4	7.3	72.4	7.3	72.4	7.3
25	76.0	5.5	76.0	5.5	76.0	5.5	76.0	5.5
50	78.5	3.9	78.5	3.9	78.5	3.9	78.5	3.9
100	80.1	3.1	80.1	3.1	80.1	3.1	80.1	3.1
SPS	84.4	0.8	84.4	0.8	84.4	0.8	84.4	0.8
Colfax Gage								
1	77.4	4.8	78.5	3.7	79.6	2.6	79.6	2.6
3	80.8	5.0	81.5	4.3	82.3	3.5	82.3	3.5
5	82.1	5.0	82.7	4.4	83.5	3.6	83.5	3.6
10	83.6	5.1	84.2	4.5	84.8	3.9	84.8	3.9
25	85.5	4.9	85.9	4.5	86.6	3.8	86.6	3.8
50	86.5	5.0	86.7	4.8	87.5	4.0	87.5	4.0
100	88.2	4.4	88.2	4.4	88.4	4.2	88.4	4.2
SPS	98.3	0	98.3	0	98.3	0	98.3	0

WATER SURFACE PROFILES

C.5.11. Backwater analyses were made of the tentatively selected plan for various flood frequencies. The water surface profiles for Bayou Rigolette for the 3-year and 5-year events are shown in Plates C-36 through C-39. Other flood frequencies were studied so that stage-frequency curves and overflow maps could be developed.



WINNFIELD
Atlanta
WINN PARISH
GRANT PARISH
34
471
122
167
1240
71
K I S A T C H I E
N A T I O N A L
A
B
C
D
IATT LAKE
Aloha
Dry Prong
SPILLWAY
R7
R6
COLFAX
Bentley
RED
RIVER
KANSAS CITY SOUTHERN
NATCHITOCHES PARISH
RAPIDES PARISH
N
A R K A N S A S
RED RIVER
STUDY AREA
Shreveport
Monroe
Vicksburg
MISSISSIPPI RIVER
Alexandria
Baton Rouge
Lake Charles
NEW ORLEANS
GULF OF MEXICO
VICINITY MAP



KISATCHIE NATIONAL FOREST
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R1
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R4
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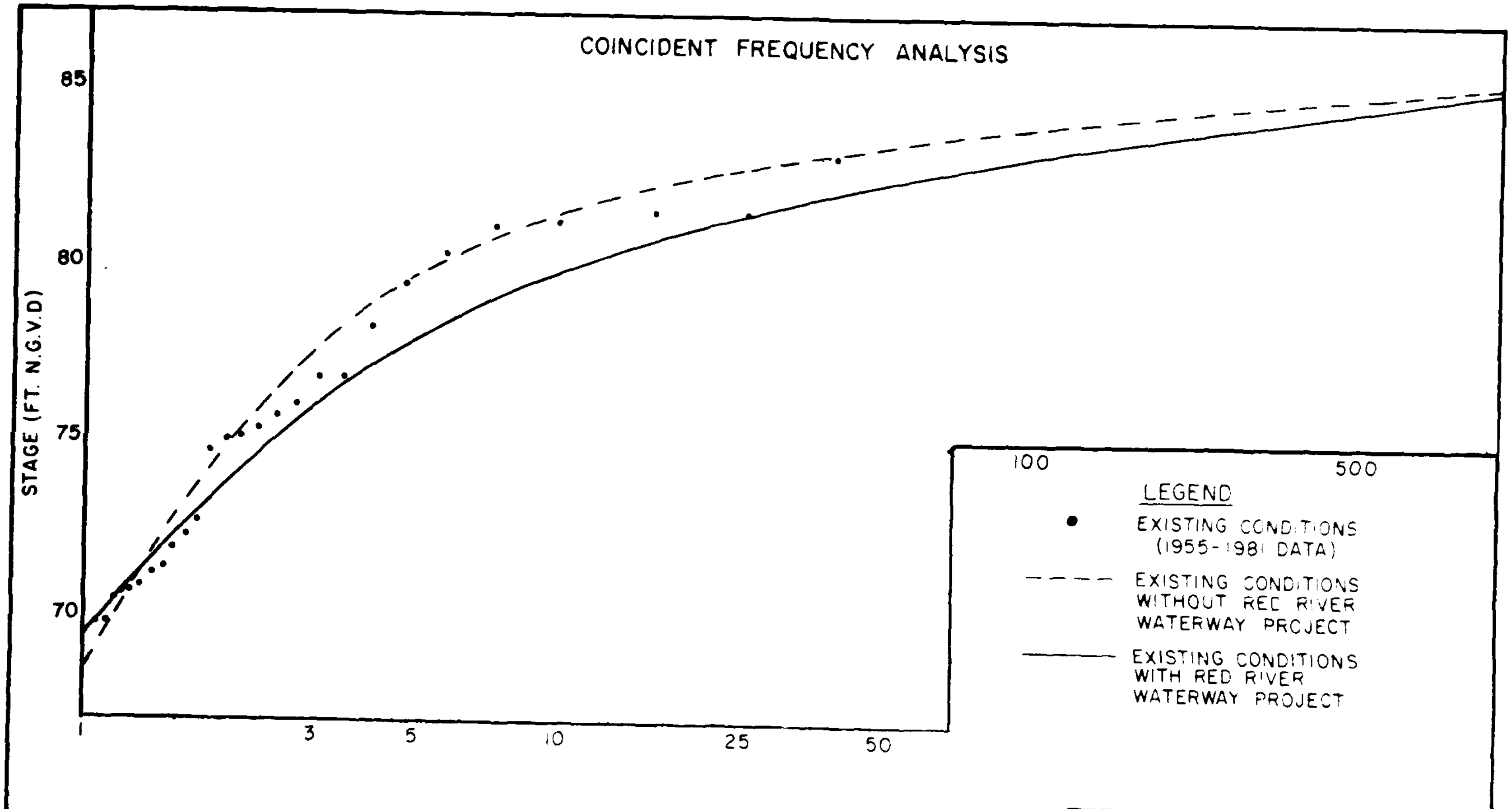
R6
R7
IATT LAKE
SPILLWAY
Aloha
COLFAX
Dry Prong
Bentley
BOYCE
PINEVILLE
ALEXANDRIA
RED RIVER
FLOODGATE
LEGEND
EXISTING LEVEE
EXISTING FLOODGATE
EXISTING SPILLWAY
STUDY BOUNDARY LINE
HILL LINES
DIVERSION CHANNEL
SUBAREA BOUNDARY
SUBAREA LETTER
REACH NUMBER
SCALE IN MILES
1 0 1 2 3 4
ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT
SUBAREAS AND
ROUTING REACHES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
U.S. ARMY ENGINEER DISTRICT
LOWER MISSISSIPPI VALLEY
FILE NO.

PLATE C-1

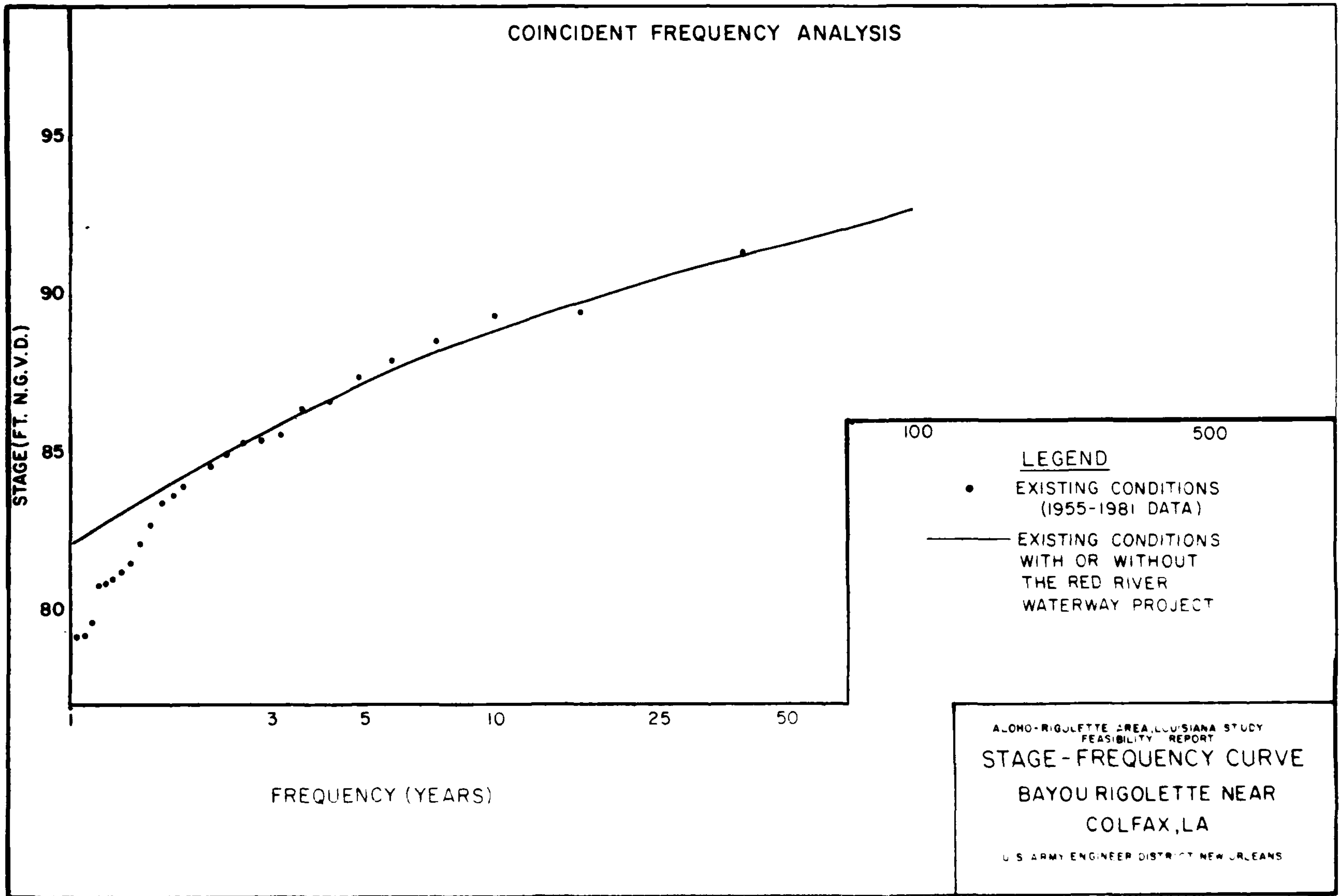


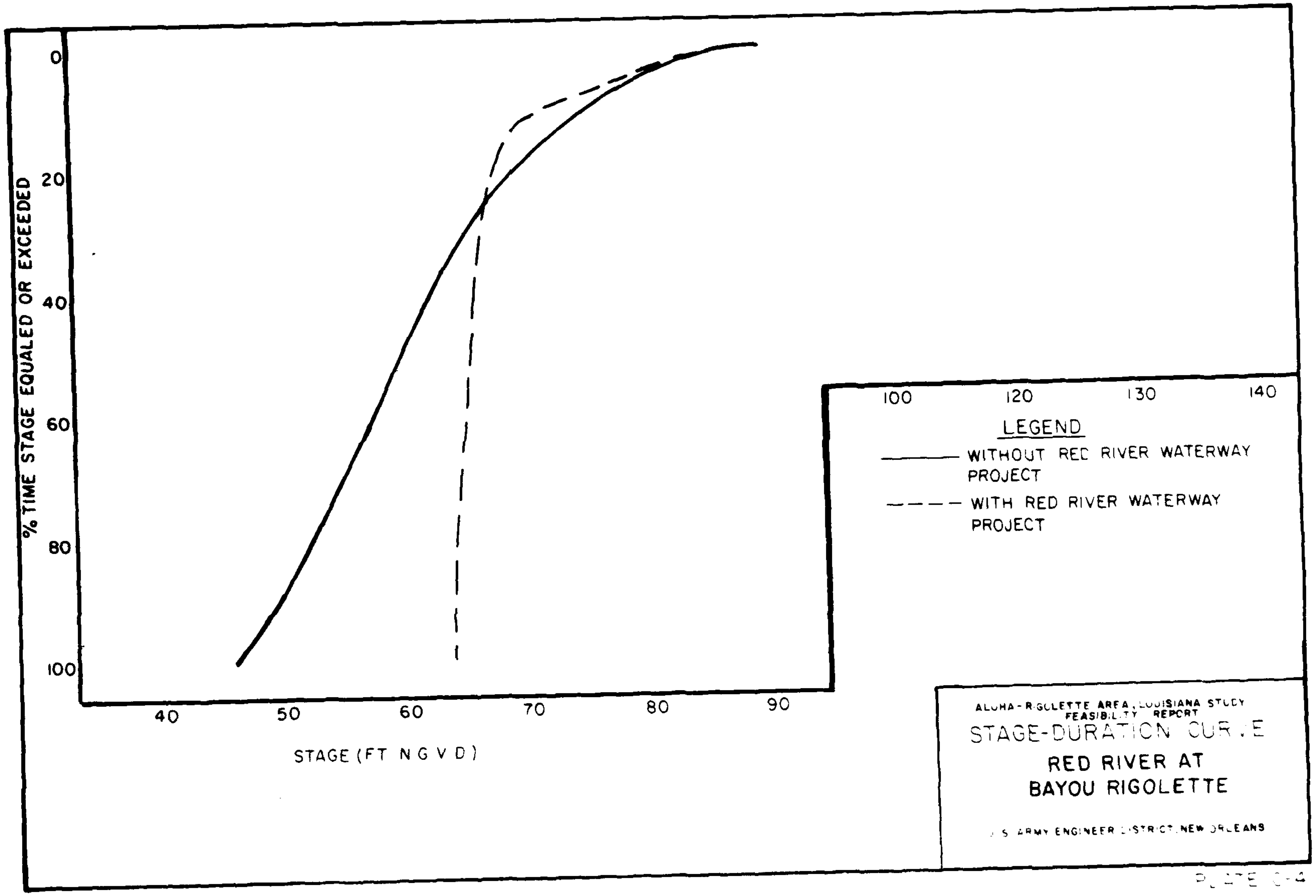
ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
PINEVILLE, LA
(3 MILES UPSTREAM OF
DRAINAGE STRUCTURE)

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS

PLATE C-2

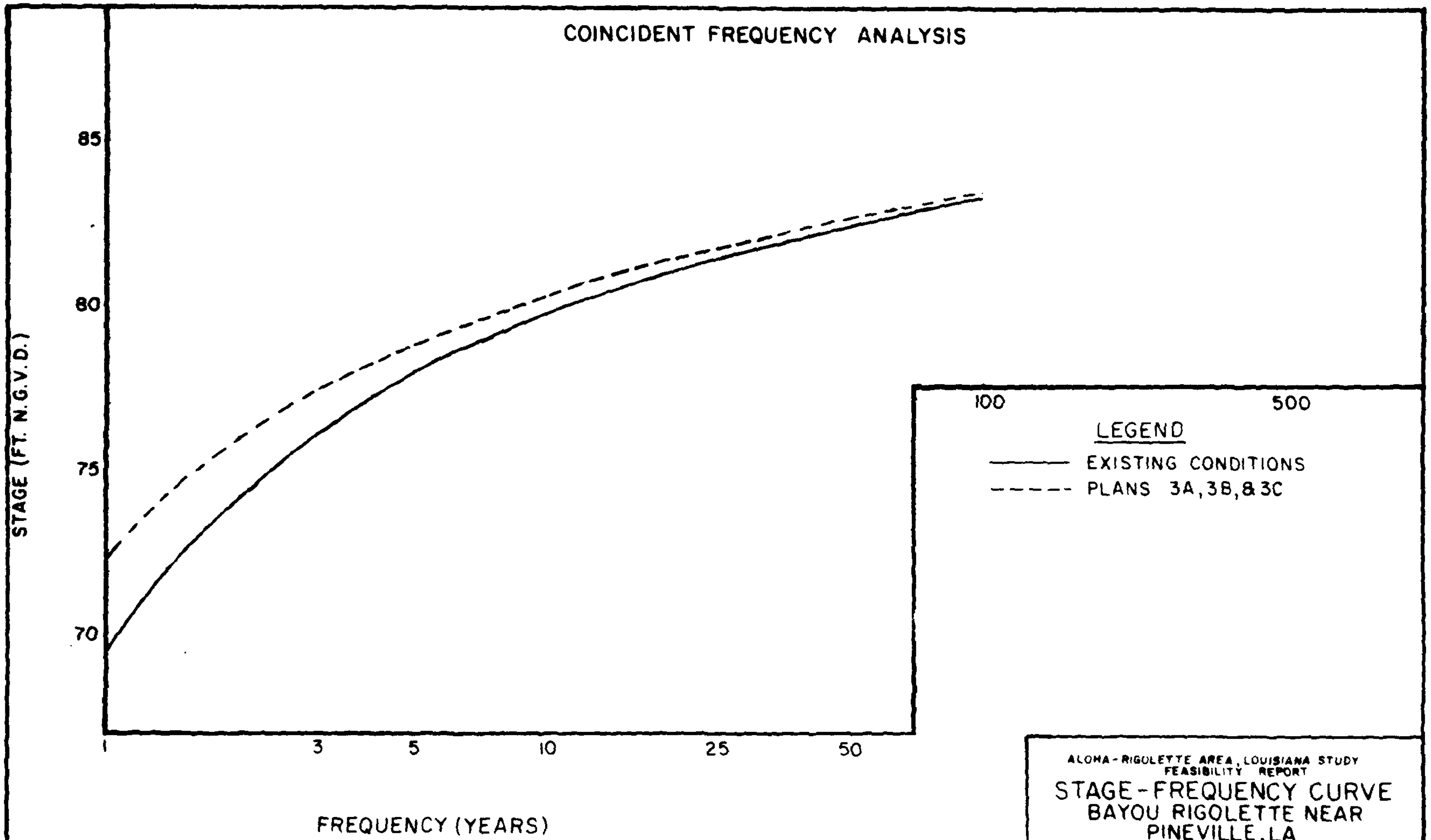

COINCIDENT FREQUENCY ANALYSIS
STAGE (FT. N.G.V.D.)
95
90
85
80
1
3
5
10
25
50
100
500
FREQUENCY (YEARS)
LEGEND
EXISTING CONDITIONS (1955-1981 DATA)
EXISTING CONDITIONS WITH OR WITHOUT THE RED RIVER WATERWAY PROJECT
ALOHO-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT
STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
COLFAX, LA
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS



ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT
STAGE-DURATION CURVE
RED RIVER AT
BAYOU RIGOLETTE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-4

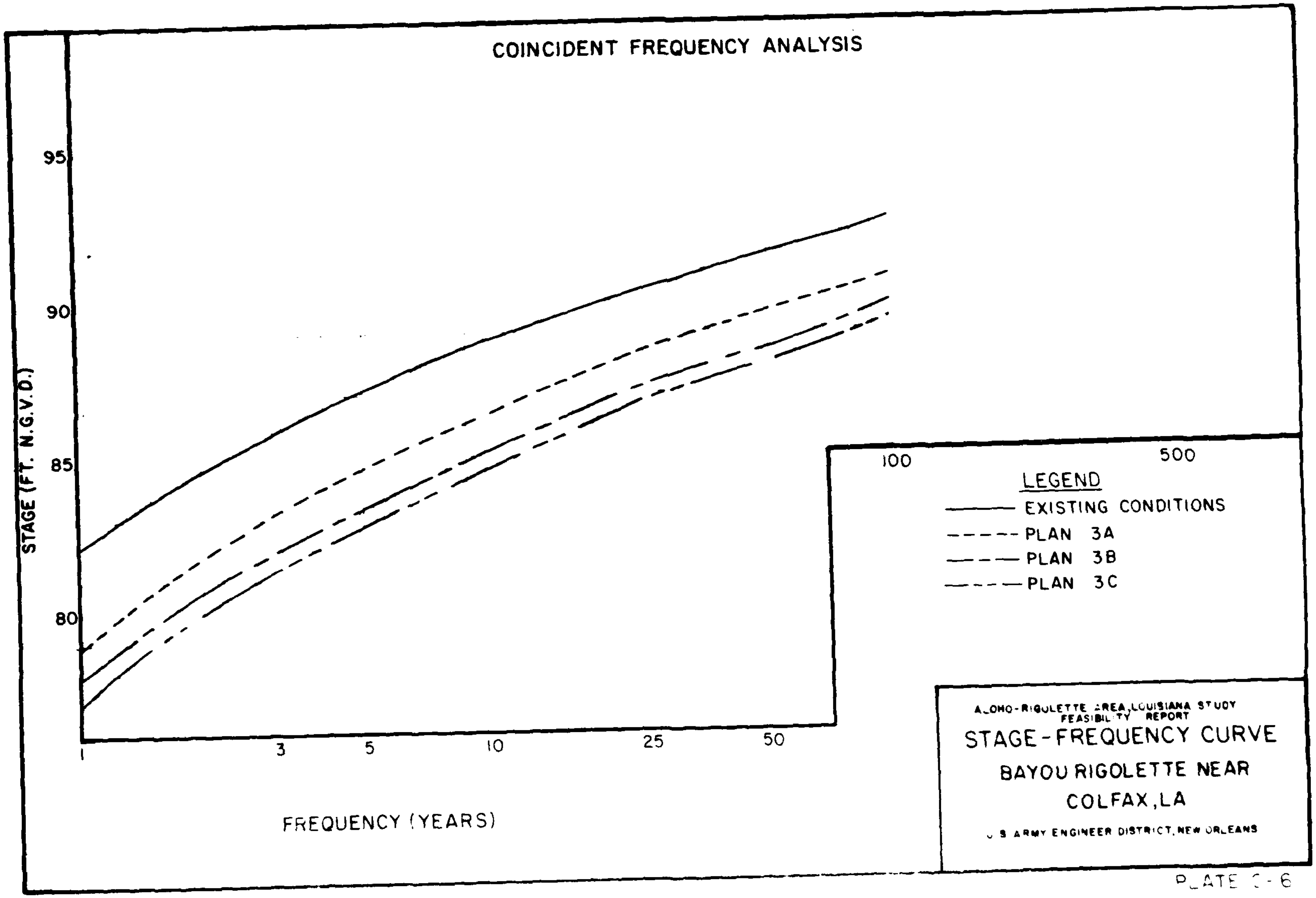


ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
PINEVILLE, LA
(3 MILES UPSTREAM OF
DRAINAGE STRUCTURE)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE

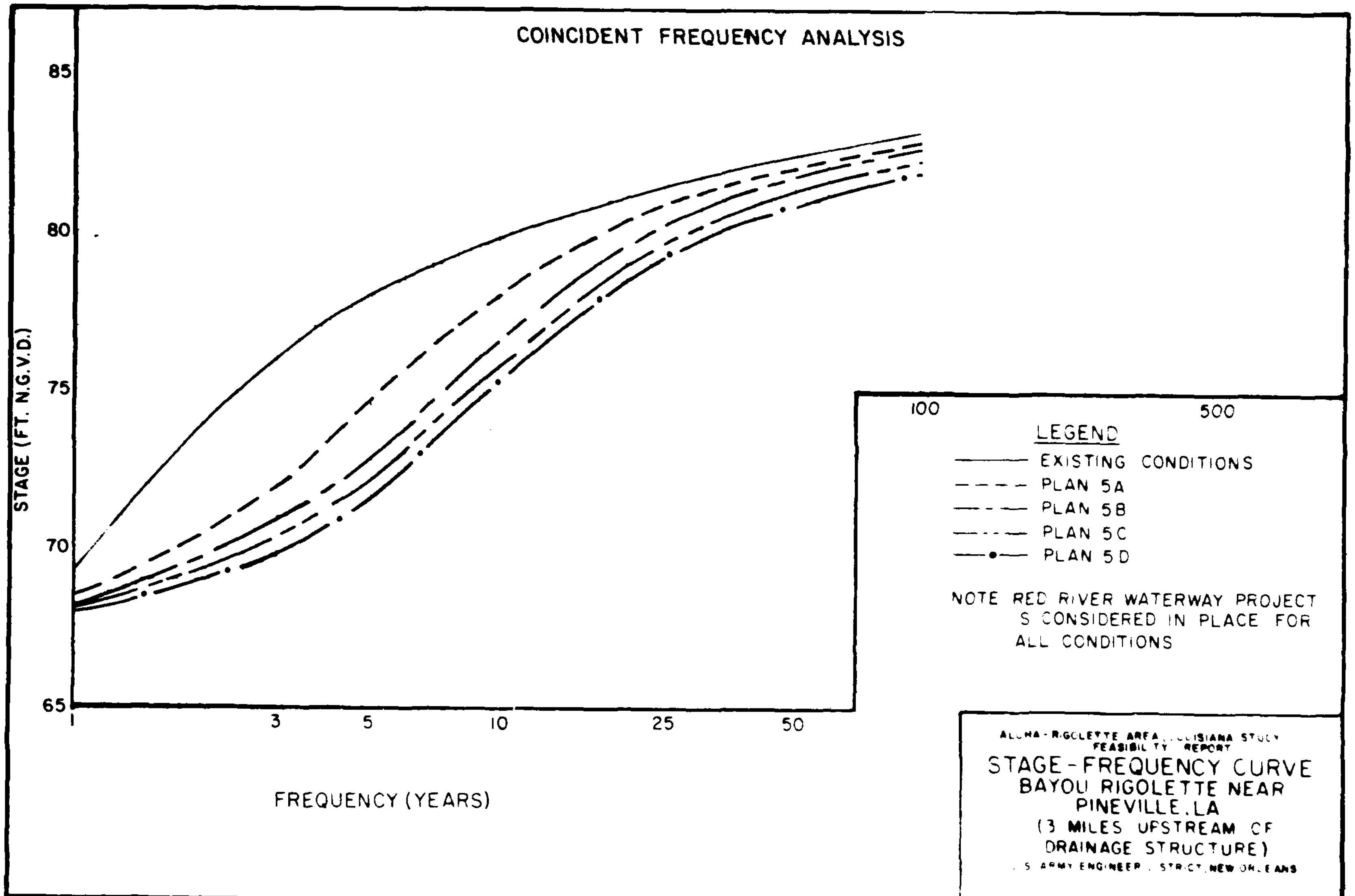


ALOHO-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
COLFAX, LA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-6



ALOHA - RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE - FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
PINEVILLE, LA
(3 MILES UPSTREAM OF
DRAINAGE STRUCTURE)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

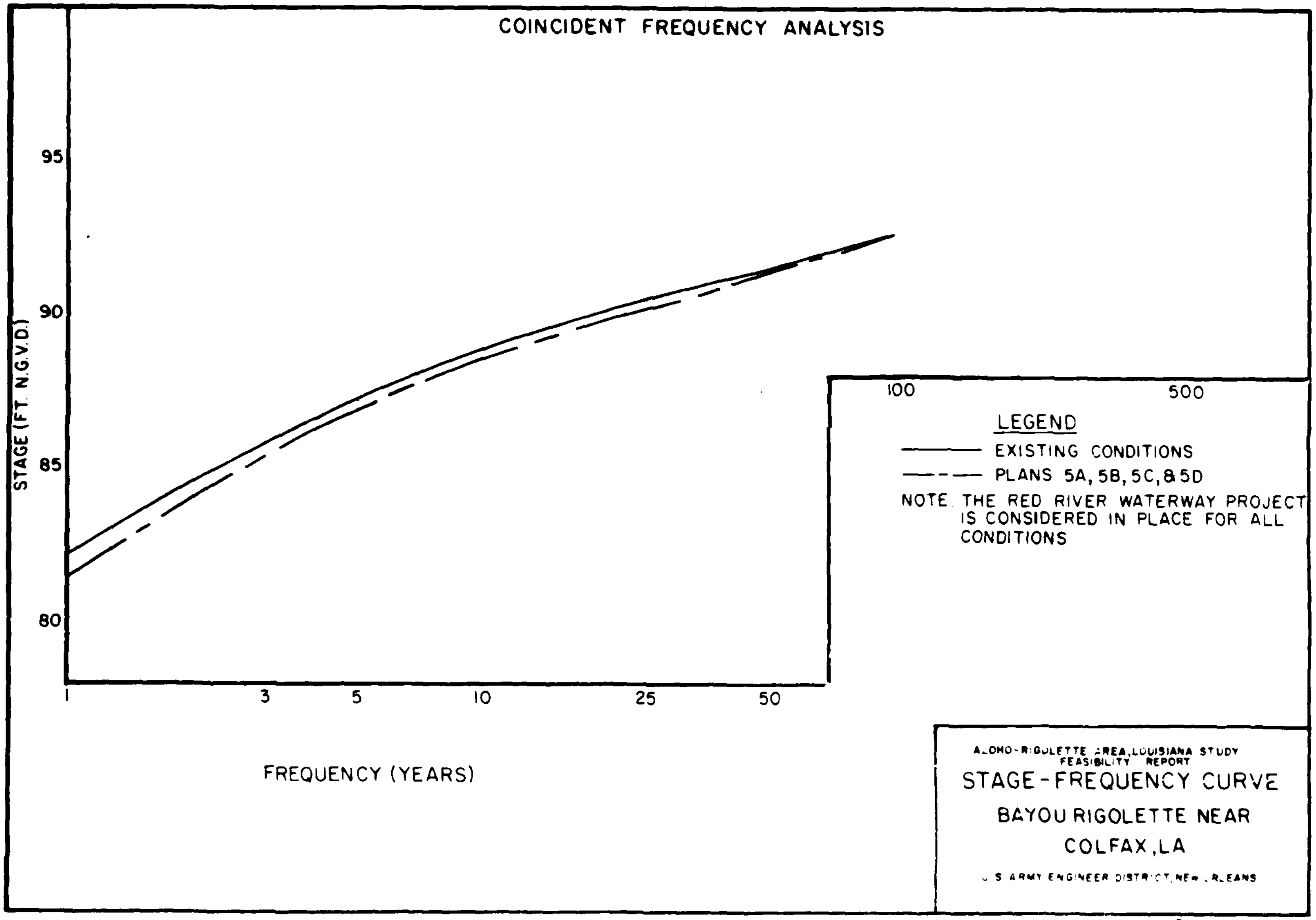
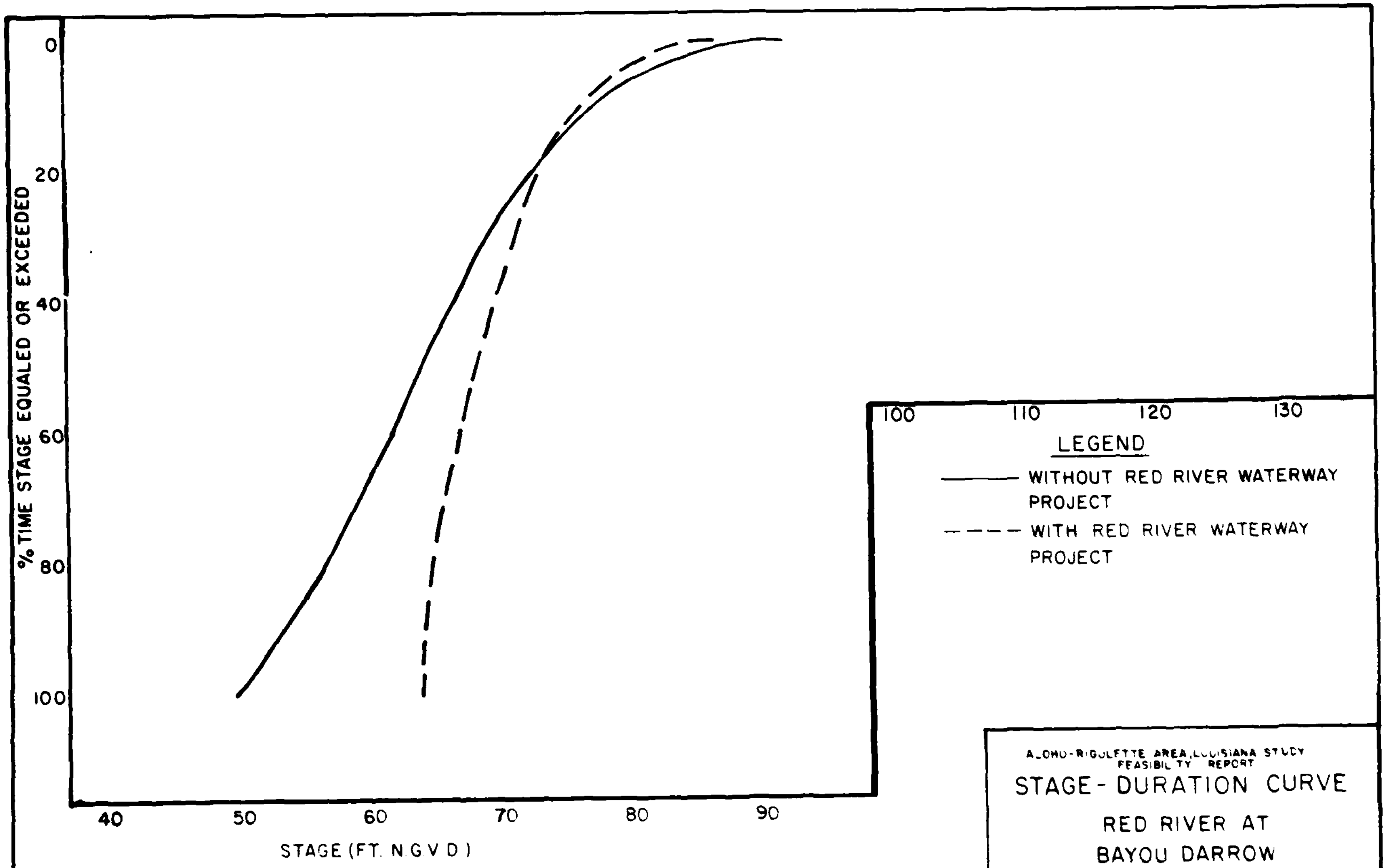

COINCIDENT FREQUENCY ANALYSIS
STAGE (FT. N.G.V.D.)
95
90
85
80
1
3
5
10
25
50
100
500
FREQUENCY (YEARS)
LEGEND
EXISTING CONDITIONS
PLANS 5A, 5B, 5C, & 5D
NOTE. THE RED RIVER WATERWAY PROJECT IS CONSIDERED IN PLACE FOR ALL CONDITIONS
STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
COLFAX, LA

PLATE C-8



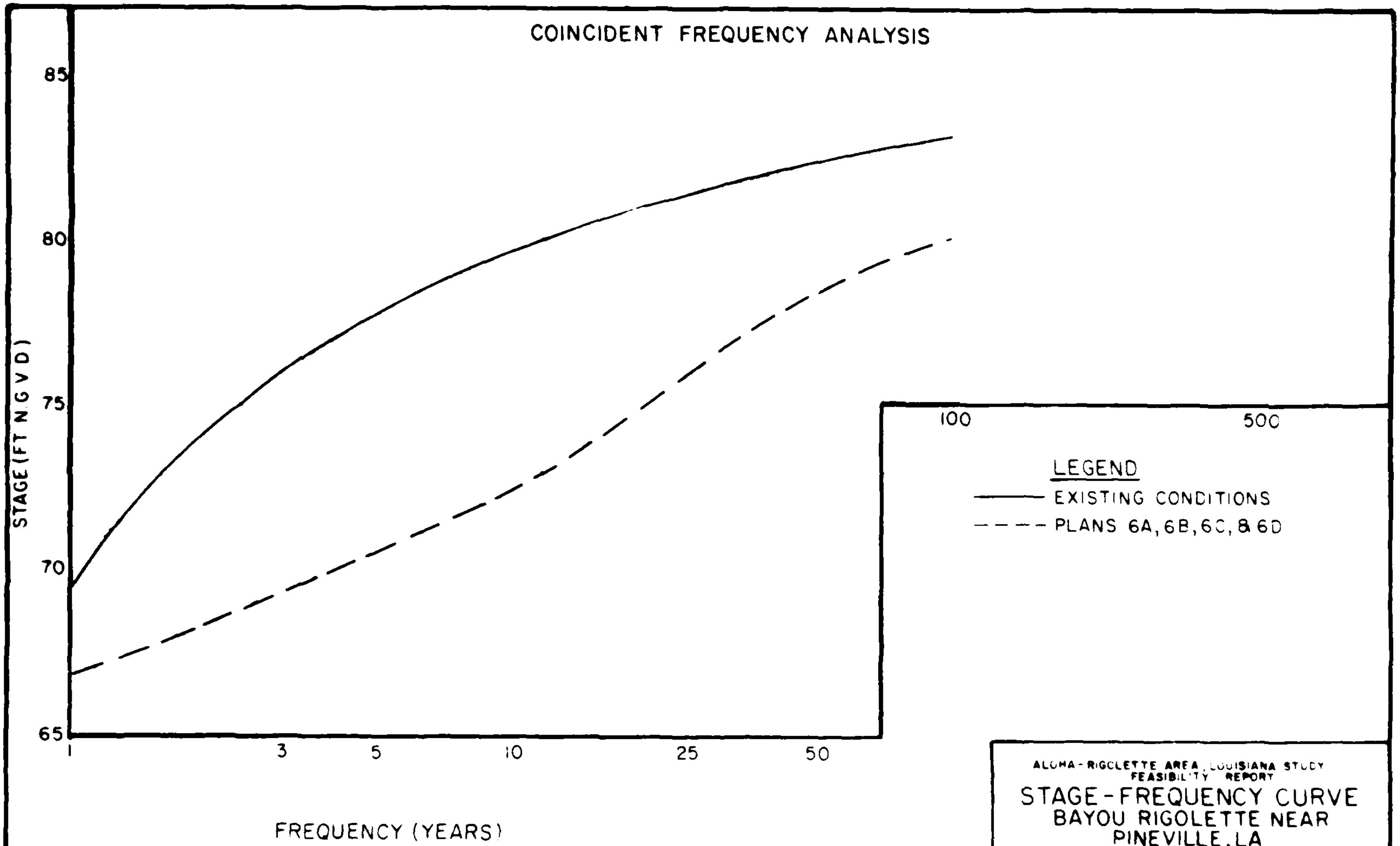
ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-DURATION CURVE

RED RIVER AT
BAYOU DARROW

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS

PLATE

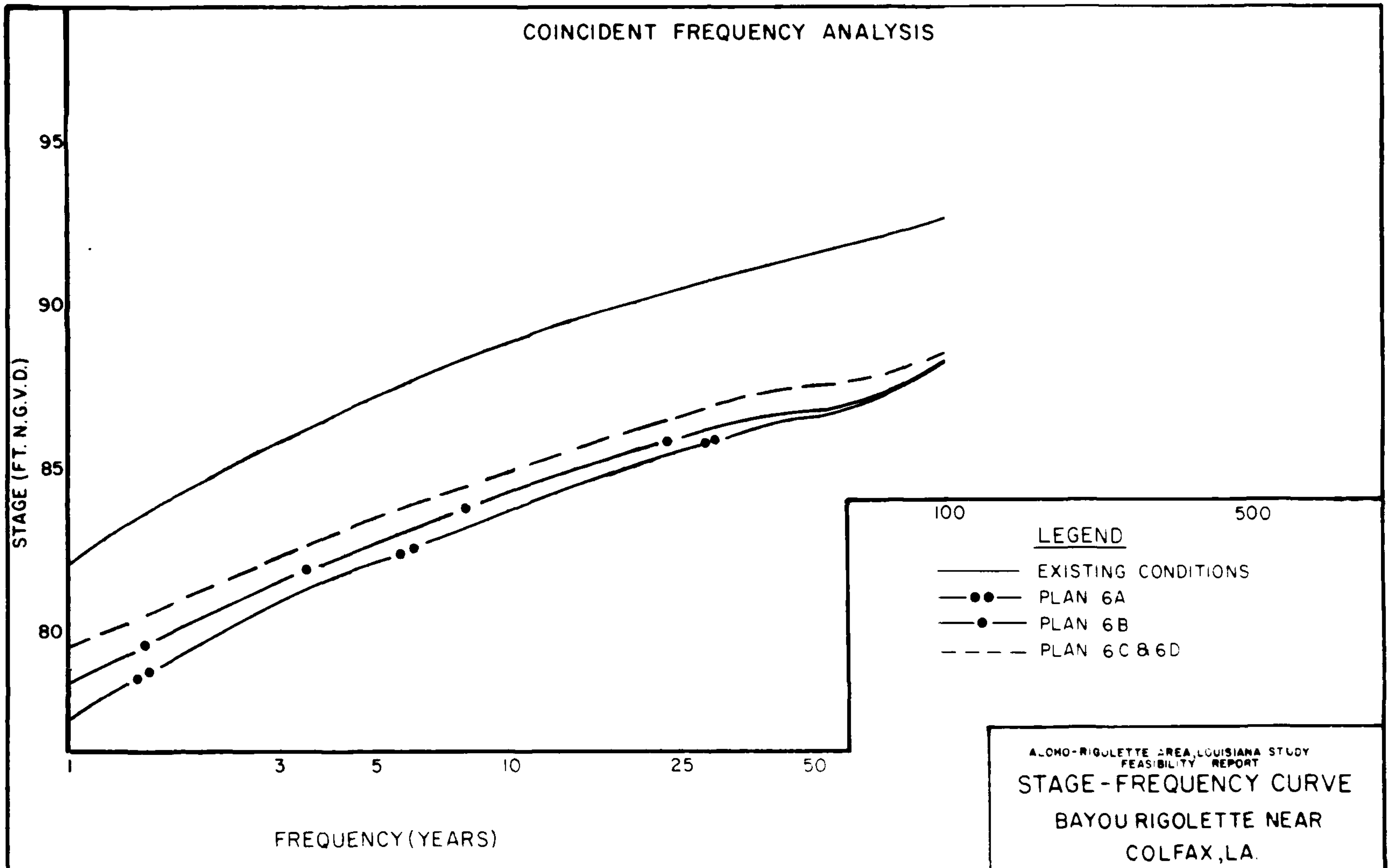


ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
PINEVILLE, LA
(3 MILES UPSTREAM OF
DRAINAGE STRUCTURE)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE



ALOHO-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

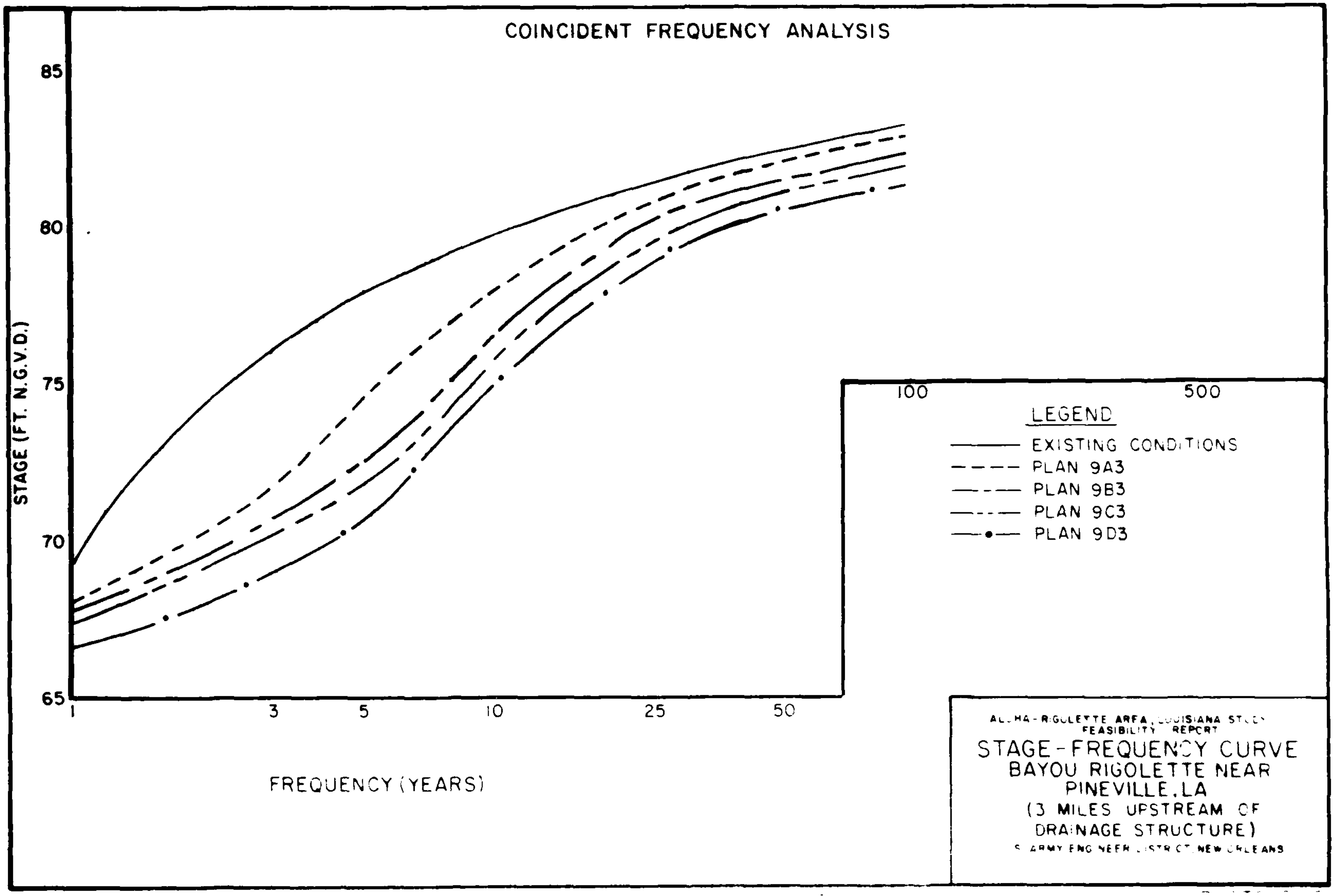
STAGE - FREQUENCY CURVE

BAYOU RIGOLETTE NEAR

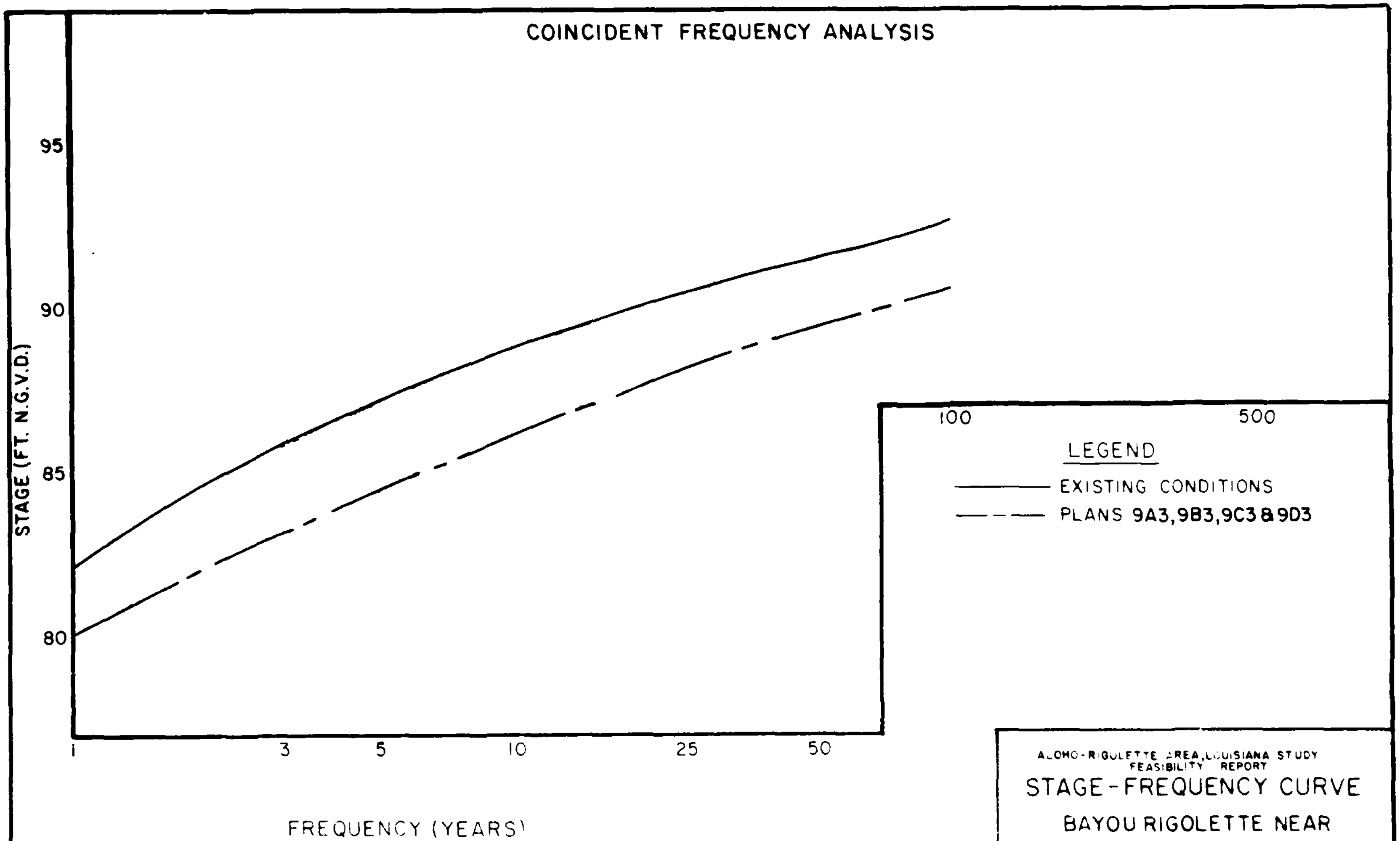
COLFAX, LA.

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-



STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
PINEVILLE, LA
(3 MILES UPSTREAM OF
DRAINAGE STRUCTURE)



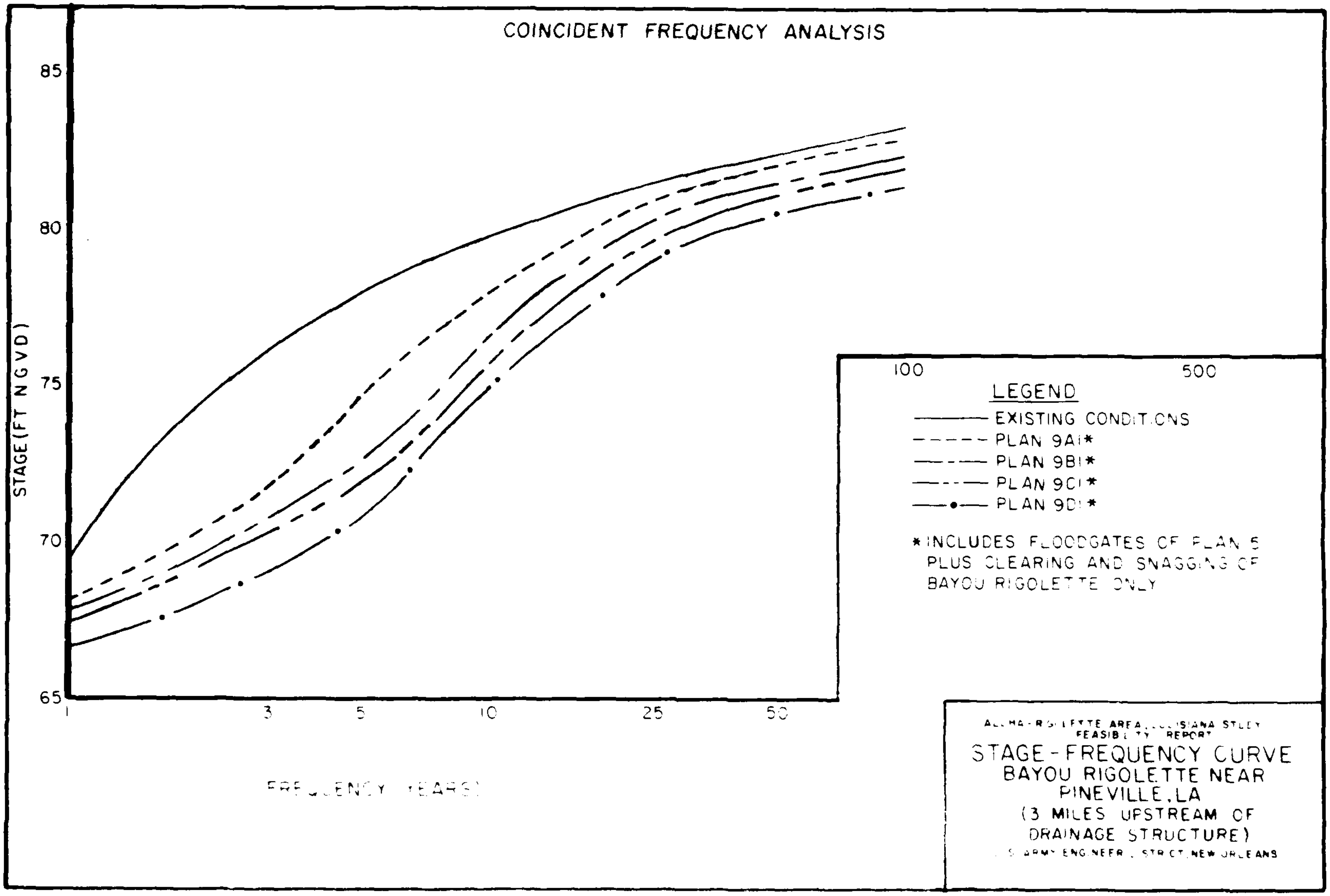
ALOHO-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-FREQUENCY CURVE

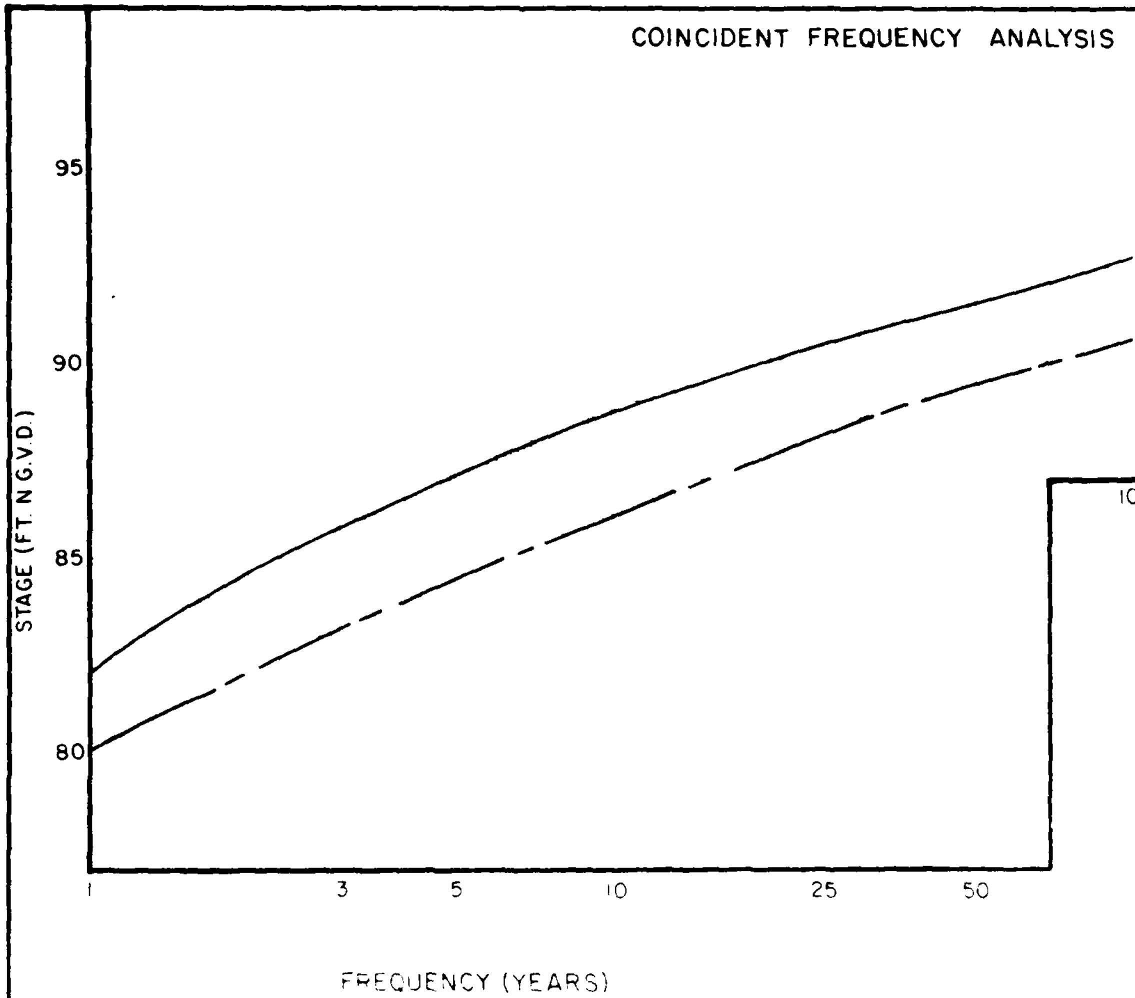
BAYOU RIGOLETTE NEAR

COLFAX, LA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS



STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
PINEVILLE, LA
(3 MILES UPSTREAM OF
DRAINAGE STRUCTURE)



LEGEND

———— EXISTING CONDITIONS

— — — PLANS 9AI*, 9BI*, 9CI*, 9D*

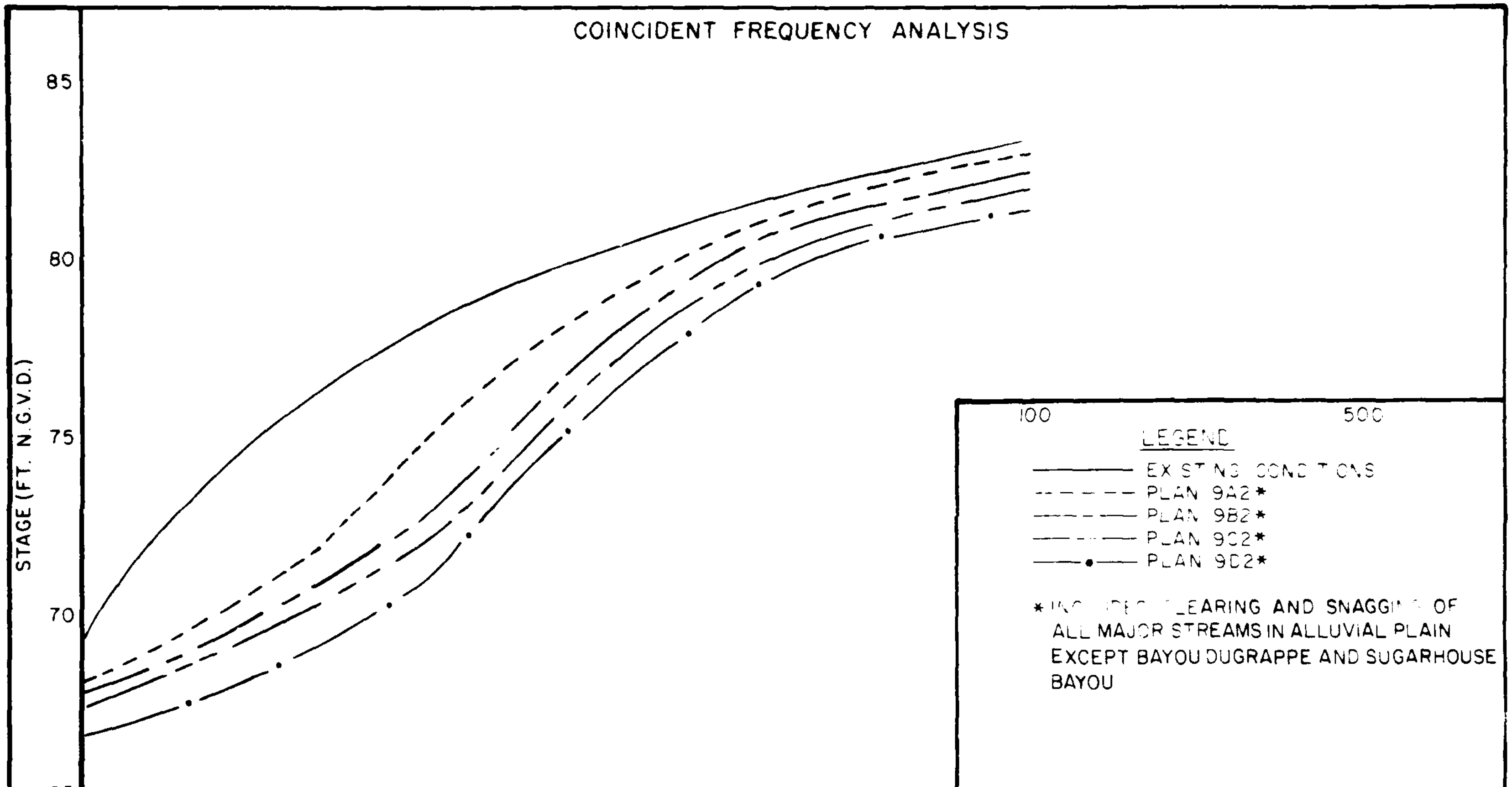
* INCLUDES FLOODGATE OF PLAN 5 PLUS CLEARING AND SNAGGING OF BAYOU RIGOLETTE ONLY

ALOHO-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
COLFAX, LA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE 5

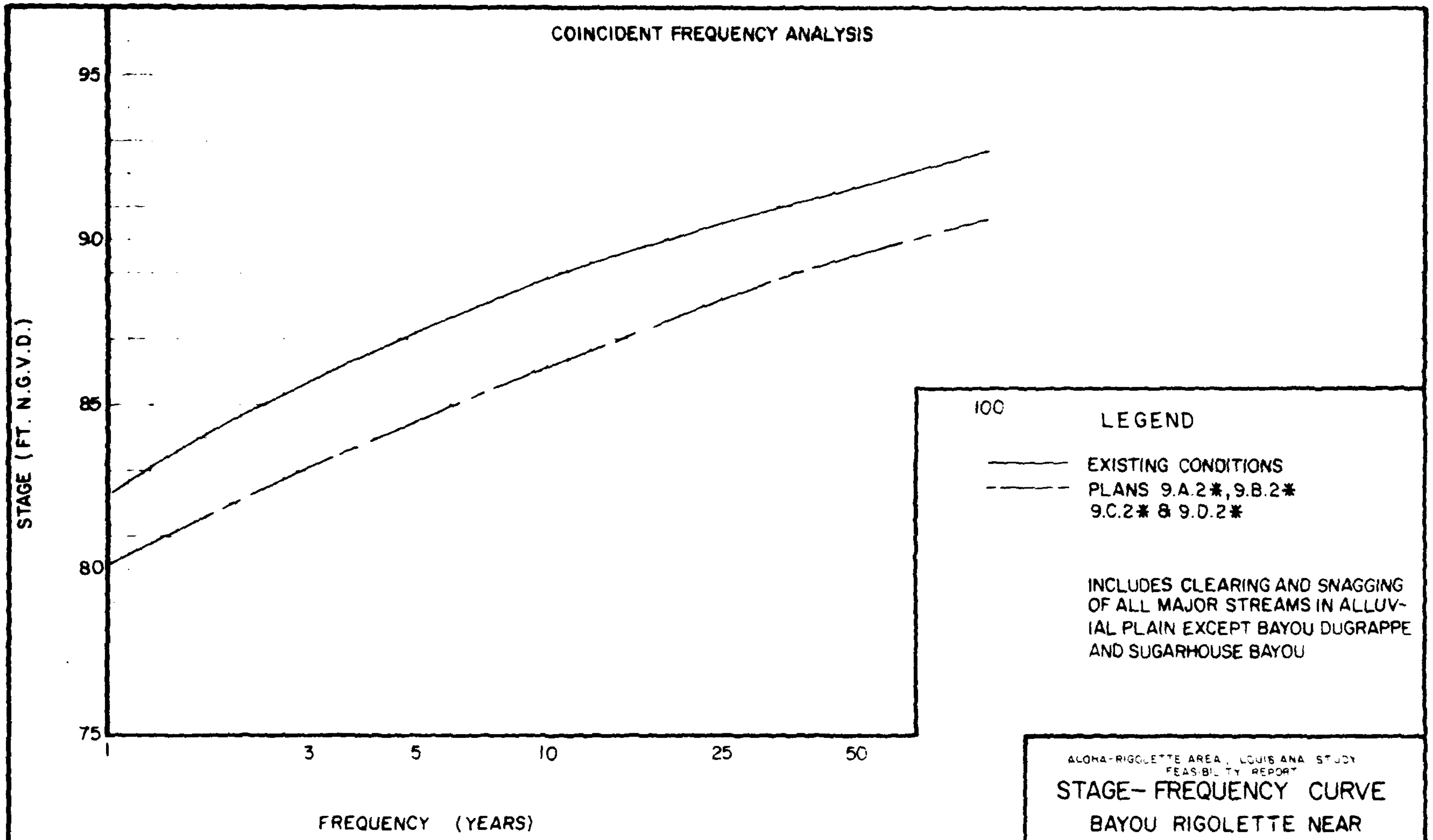


ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
PINEVILLE, LA.
(3 MILES UPSTREAM OF
DRAINAGE STRUCTURE)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-16

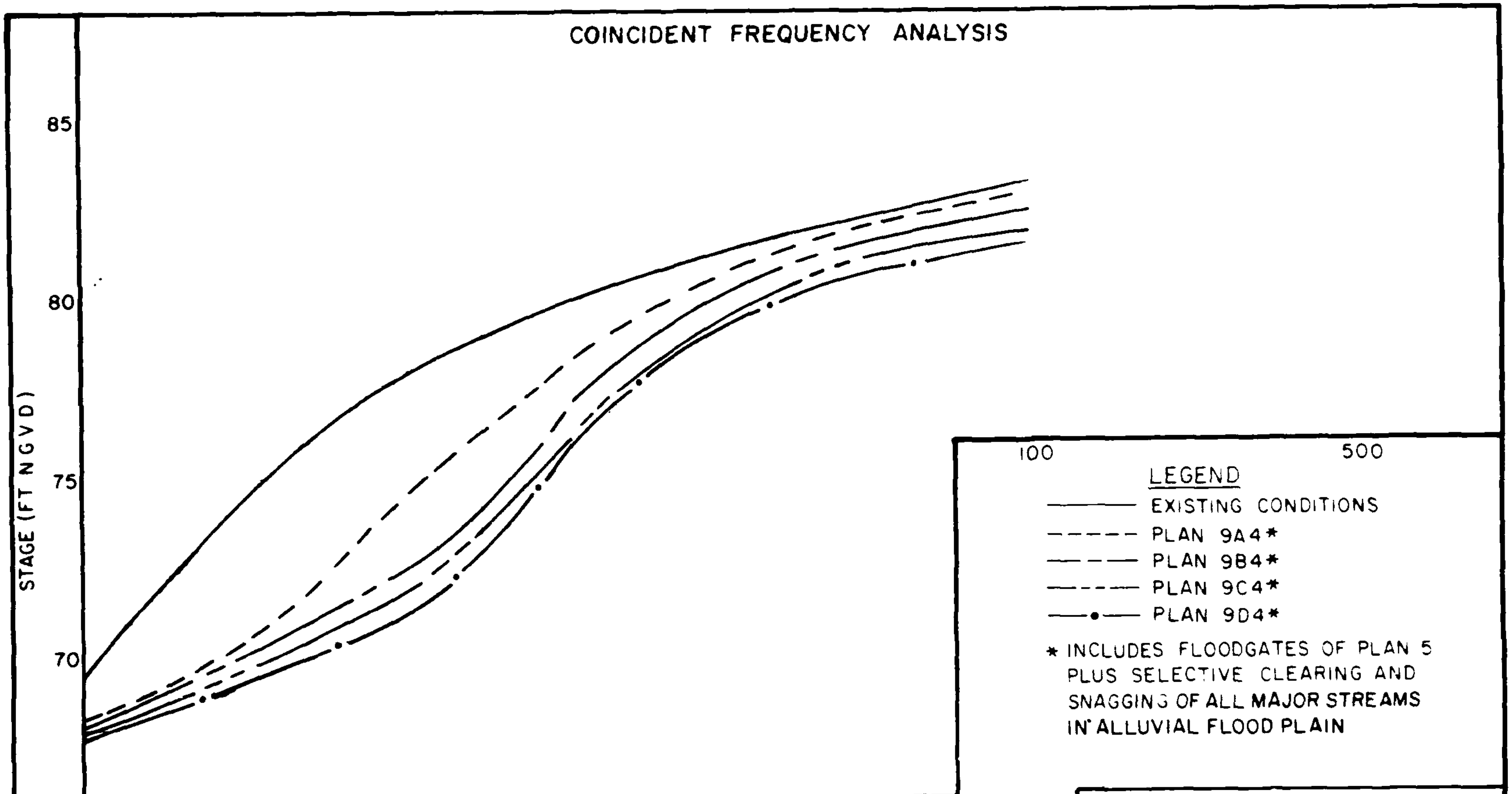


ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE– FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
COLFAX, LA.

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-17

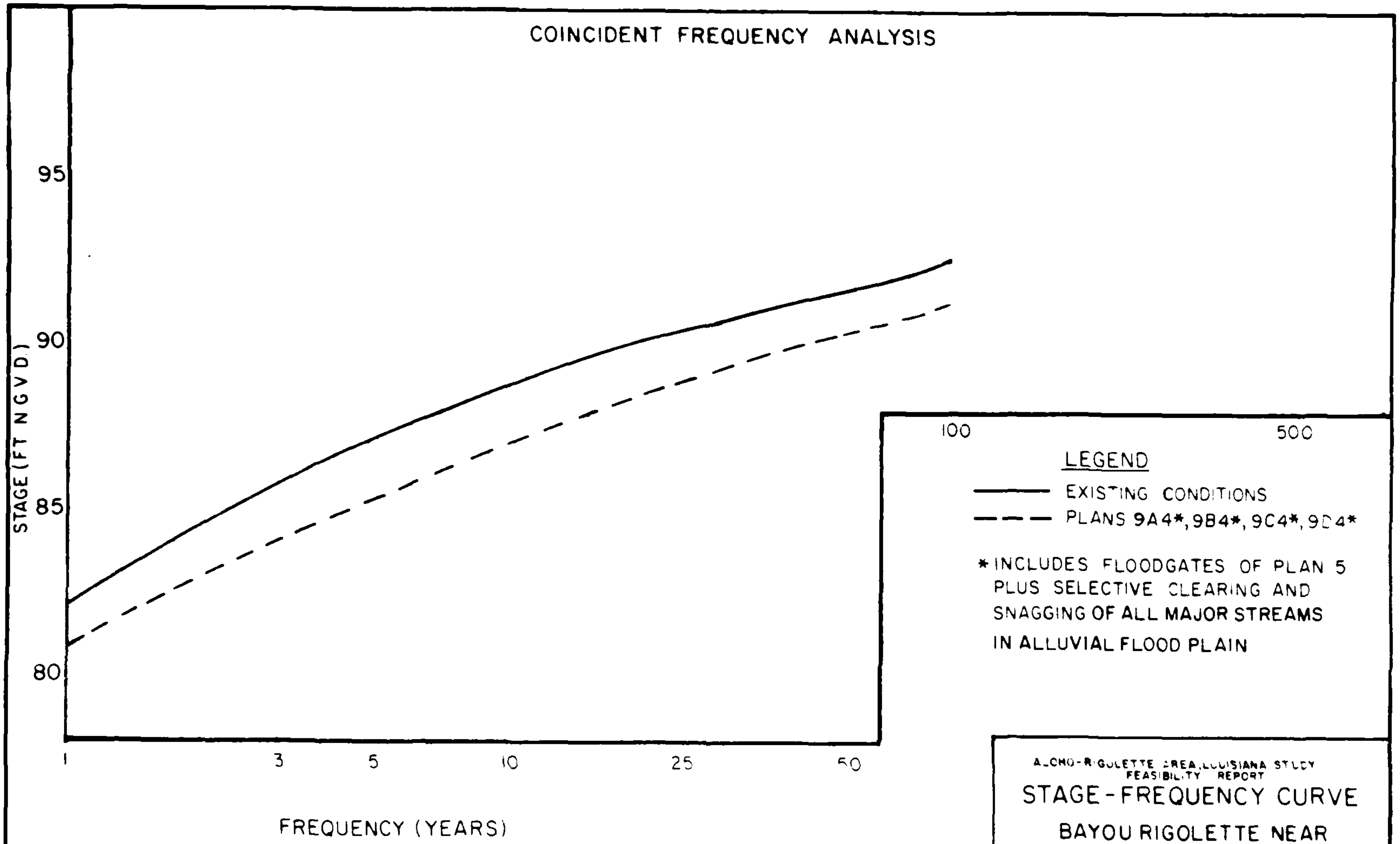


ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR PINEVILLE, LA.
(3 MILES UPSTREAM OF DRAINAGE STRUCTURE)

U S ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-18



ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

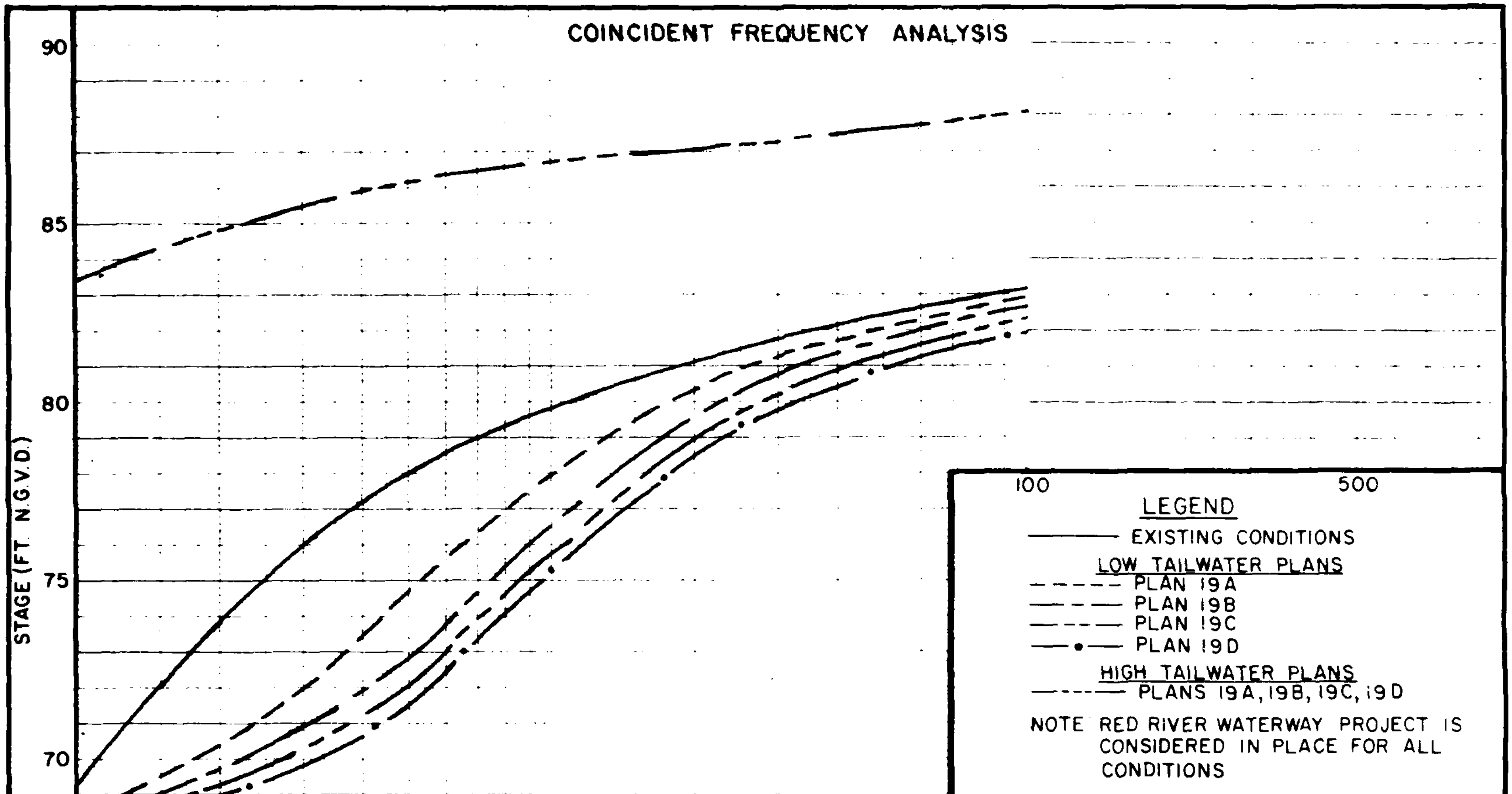
STAGE - FREQUENCY CURVE

BAYOU RIGOLETTE NEAR

COLFAX, LA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

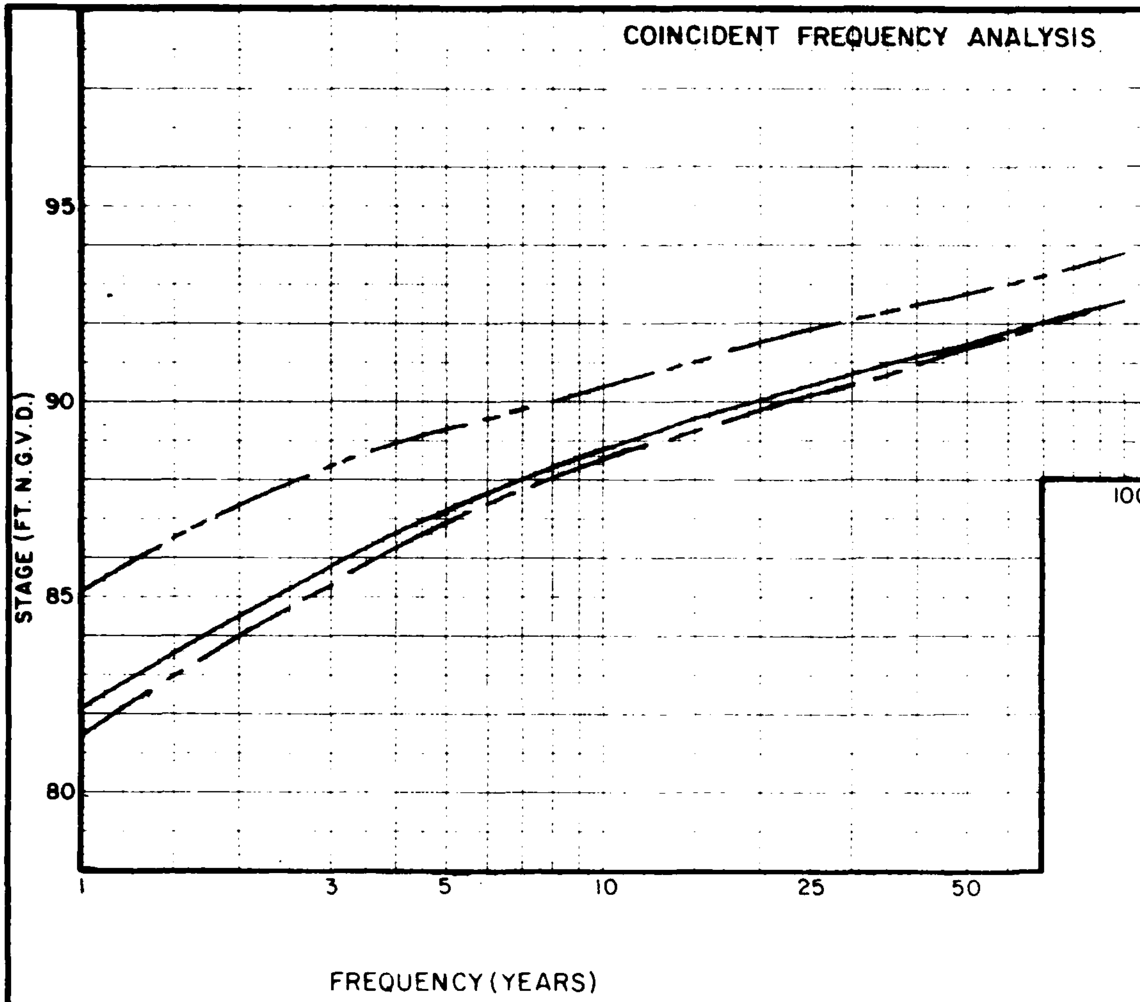
PLATE C-19



ALOHA - RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE - FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
PINEVILLE, LA.
(3 MILES UPSTREAM OF
DRAINAGE STRUCTURE)

U S ARMY ENGINEER DISTRICT, NEW ORLEANS



LEGEND

——— EXISTING CONDITIONS

LOW TAILWATER PLANS

— - — PLANS 19A, 19B, 19C, 19D

HIGH TAILWATER PLANS

— - - — PLANS 19A, 19B, 19C, 19D

NOTE RED RIVER WATERWAY PROJECT IS CONSIDERED IN PLACE FOR ALL CONDITIONS

ALOHO-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

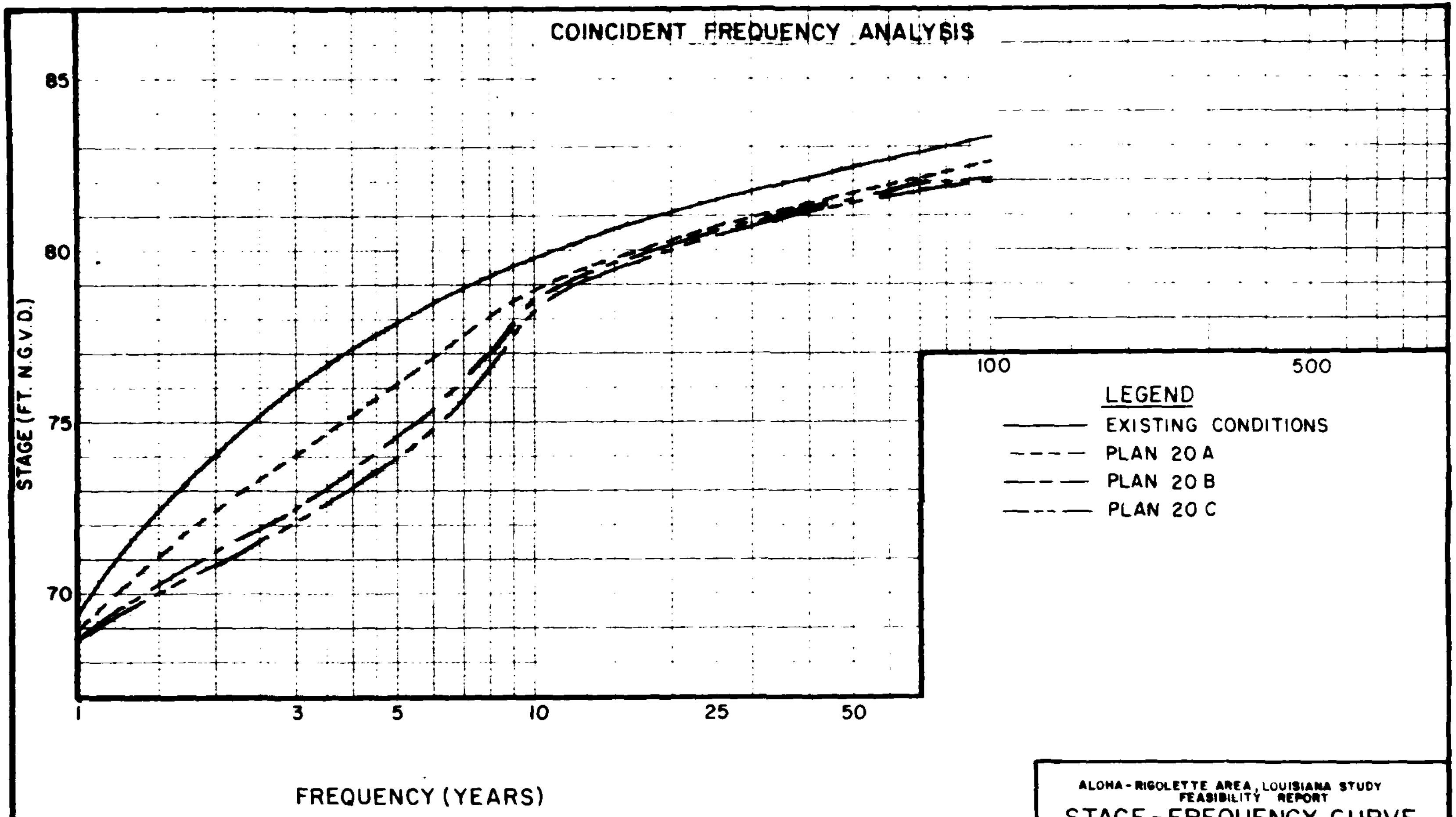
STAGE - FREQUENCY CURVE

BAYOU RIGOLETTE NEAR

COLFAX, LA.

U S ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-21

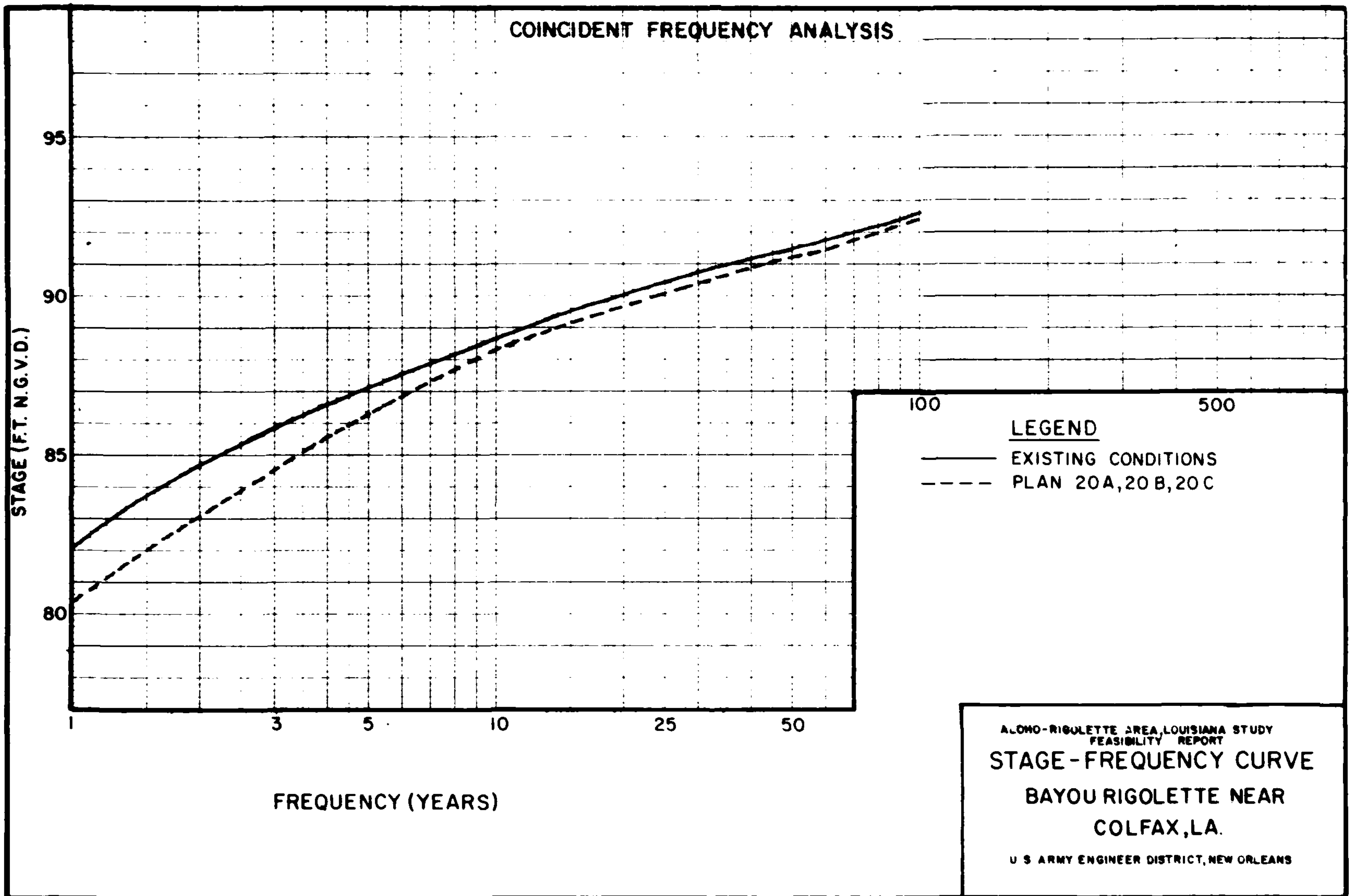


ALOHA-RIGOLETTE AREA, LOUISIANA STUDY FEASIBILITY REPORT

STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR PINEVILLE, LA.
(3 MILES UPSTREAM OF DRAINAGE STRUCTURE)

U S ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-22



ALOHO-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

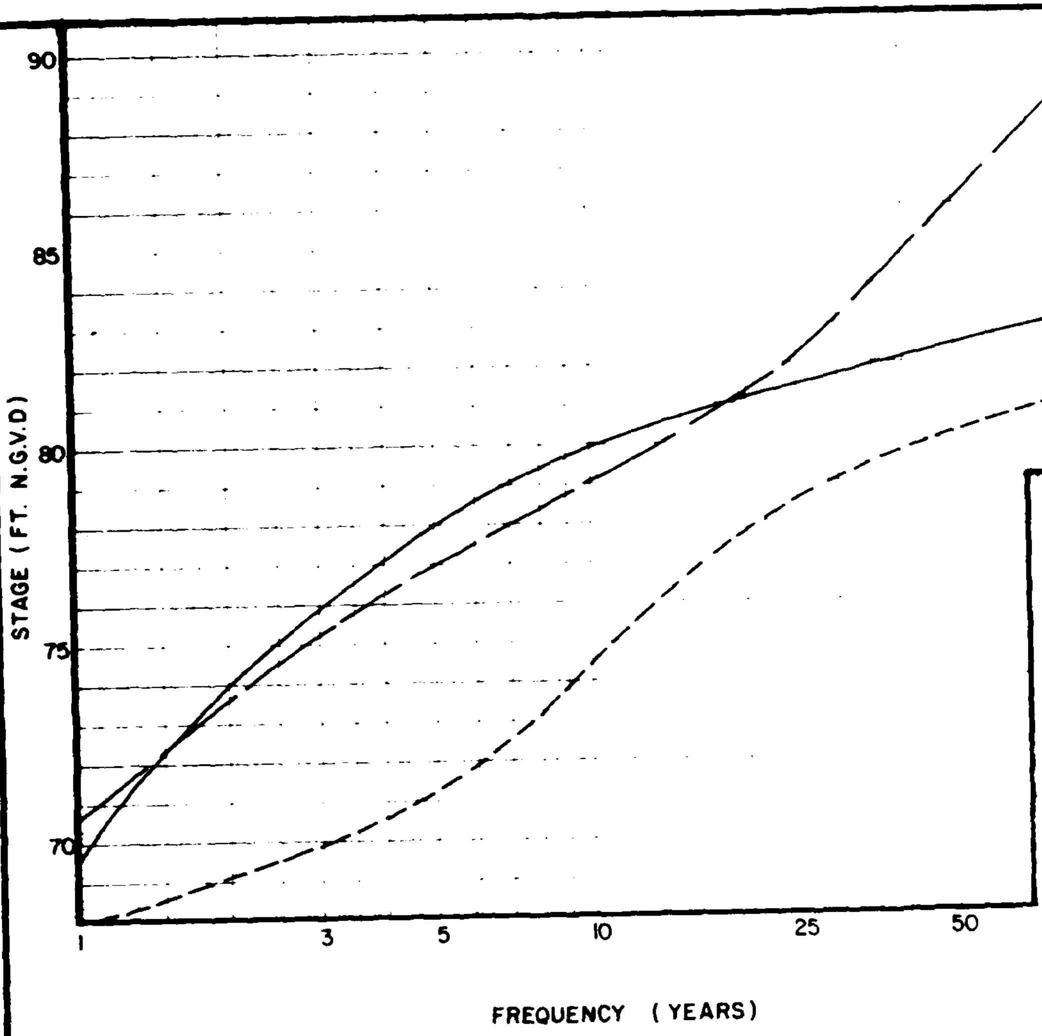
STAGE-FREQUENCY CURVE

BAYOU RIGOLETTE NEAR

COLFAX, LA.

U S ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-23



LEGEND

EXISTING CONDITIONS (solid line)

PLAN 22 NO STRUCTURE ALTERNATIVE COINCIDENT FREQUENCY ANALYSIS (short dashes)

PLAN 22 NO STRUCTURE ALTERNATIVE RED RIVER BACKWATER (long dashes)

NOTE: ALL CONDITIONS INCLUDE THE RED RIVER WATERWAY PROJECT

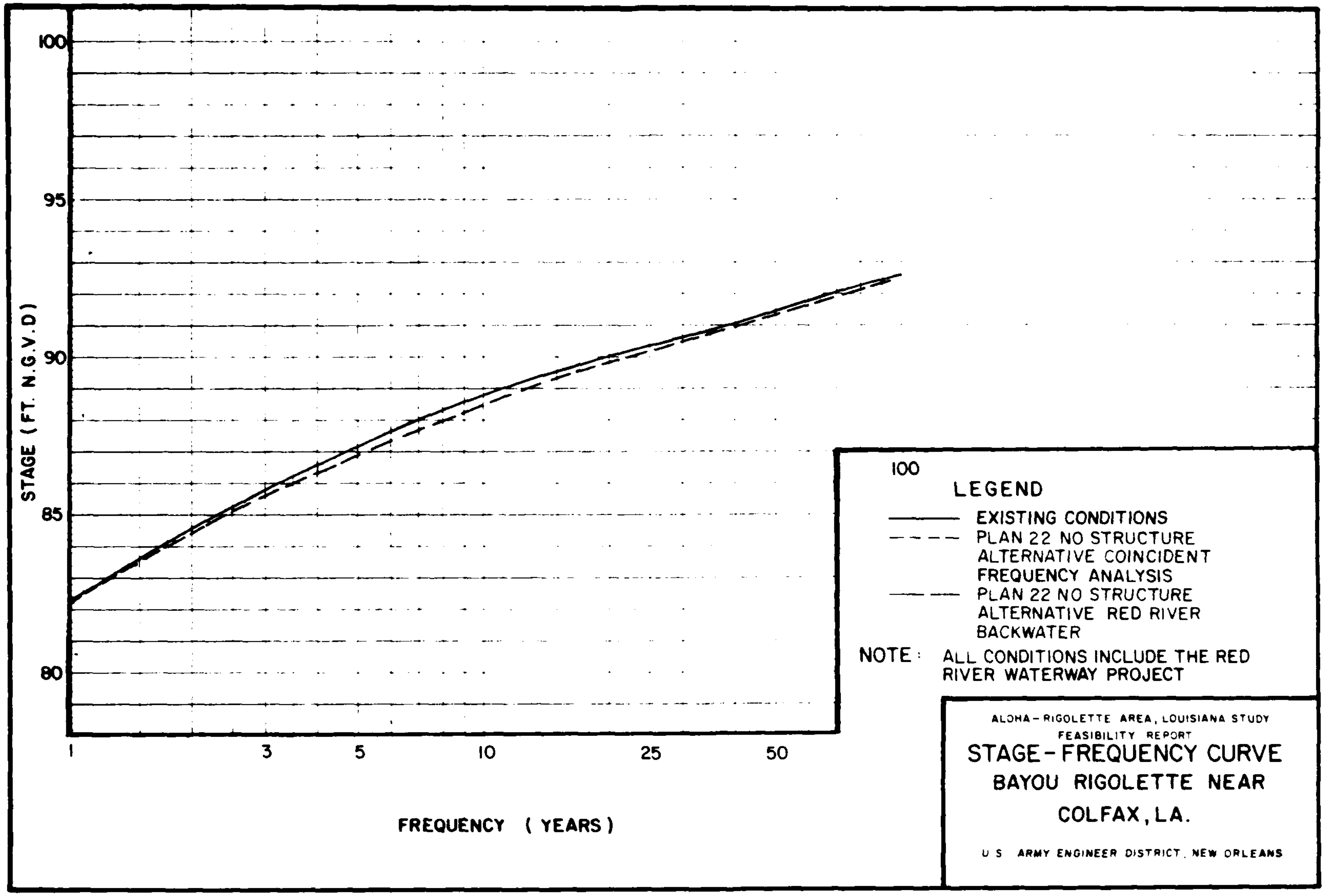
ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-FREQUENCY CURVE BAYOU RIGOLETTE NEAR PINEVILLE, LA.

(3 MILES UPSTREAM OF DRAINAGE STRUCTURE)

U S ARMY ENGINEER DISTRICT, NEW ORLEANS

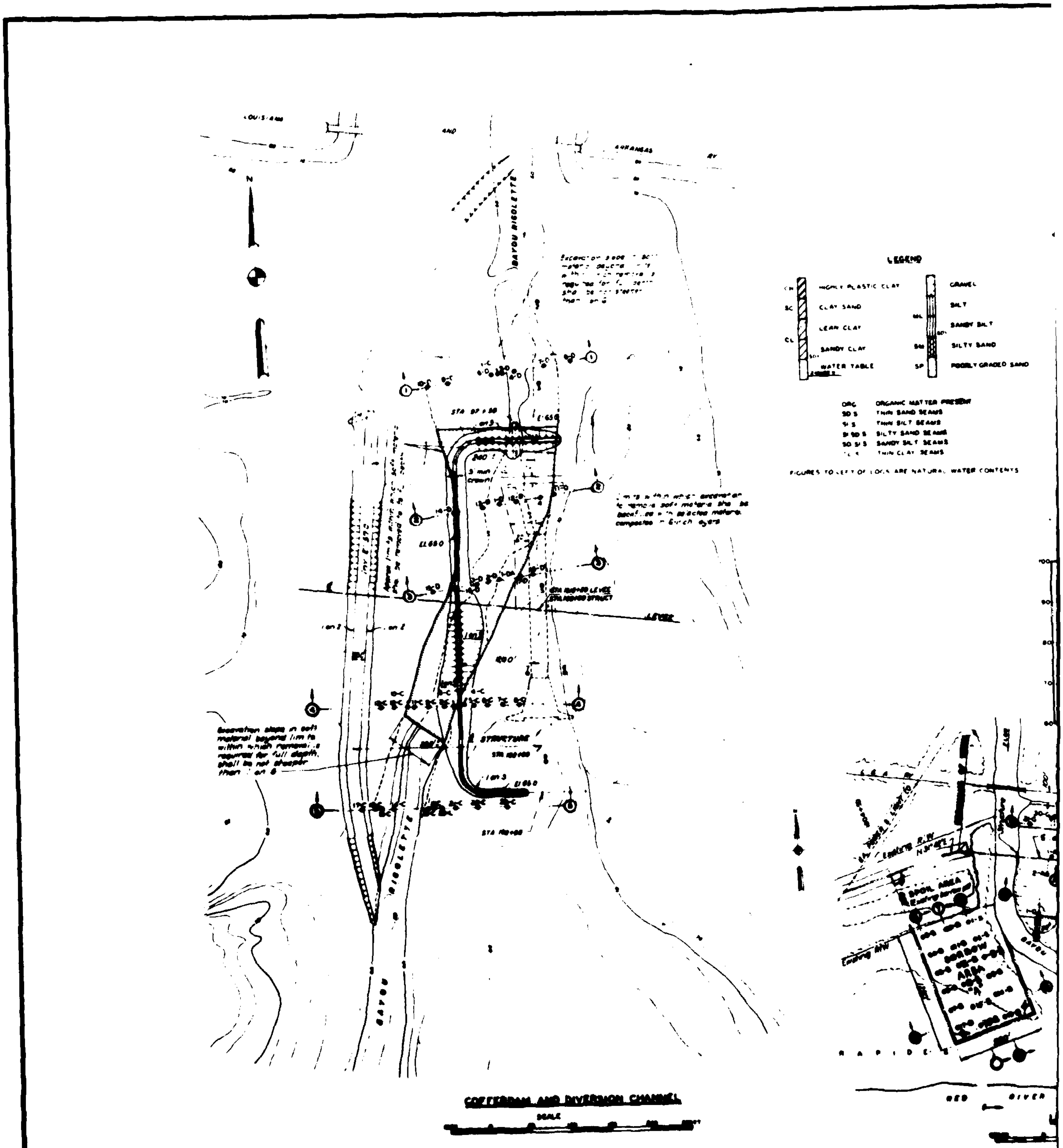
PLATE C-24



ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-FREQUENCY CURVE
BAYOU RIGOLETTE NEAR
COLFAX, LA.

U S ARMY ENGINEER DISTRICT, NEW ORLEANS



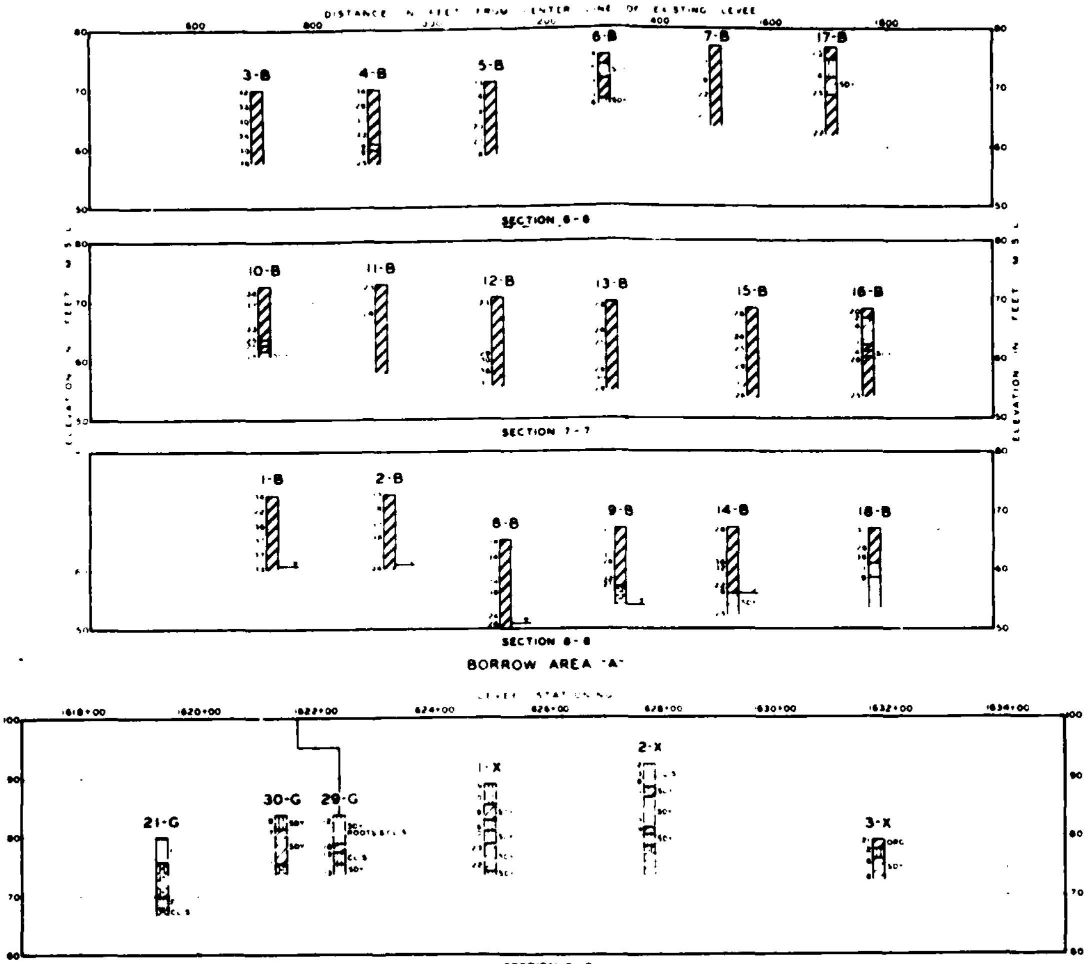
COFFERDAM AND DIVERSION CHANNEL

LEGEND

- CH — HIGHLY PLASTIC CLAY
- SC — CLAY SAND
- CL — LEAN CLAY
- SANDY CLAY
- WATER TABLE
- GRAVEL
- SILT
- ML — SANDY SILT
- SM — SILTY SAND
- SP — POORLY GRADED SAND

ORG	ORGANIC MATTER PRESENT
SD S	THIN SAND SEAMS
SI S	THIN SILT SEAMS
SI SD S	SILTY SAND SEAMS
SD SI S	SANDY SILT SEAMS
CL S	THIN CLAY SEAMS

FIGURES TO LEFT OF LOGS ARE NATURAL WATER CONTENTS



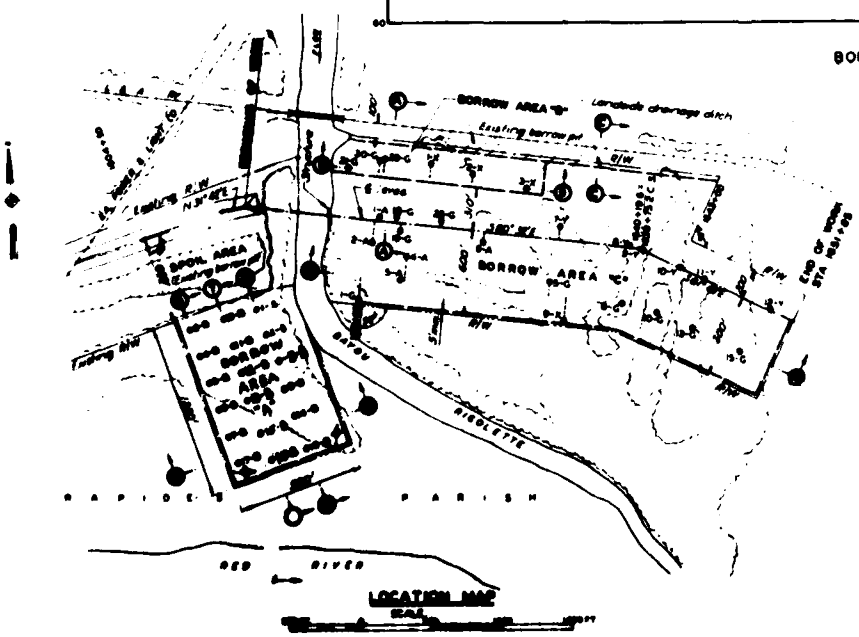
BORROW AREA "A"

BORROW AREA "B"

- GENERAL SAMPLE BORINGS
- UNDISTURBED SAMPLES TAKEN

NOTE

BORING PROFILES FOR SECTION 10-10 AND ALONG CENTERLINE OF LEVEE ARE NOT SHOWN IN THIS REPORT



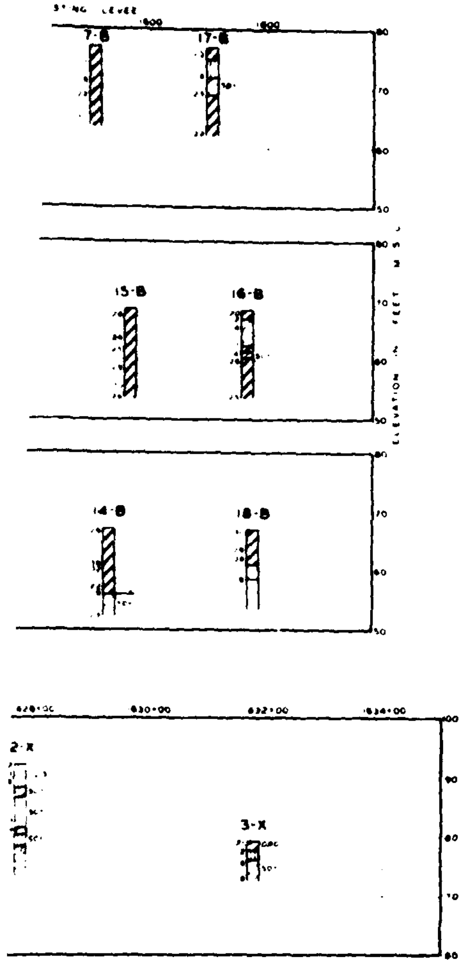
LOCATION MAP

NOTE:

PLATE TA
REPORT,
RAPIDES

BAY

BO



- GENERAL SAMPLE BORINGS
- UNDISTURBED SAMPLES TAKEN

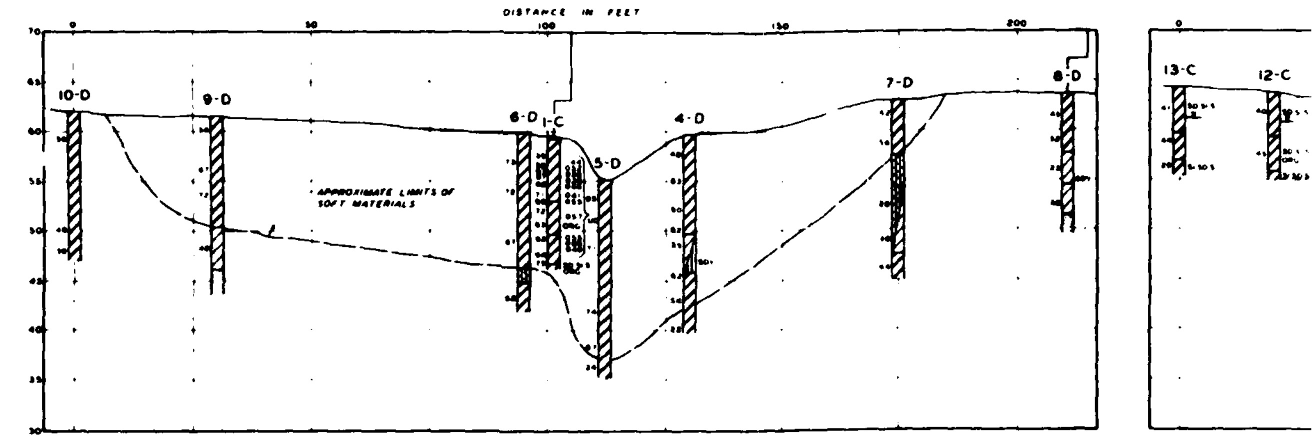
NOTE
BORING PROFILES FOR SECTION 10-10 AND ALONG CENTERLINE OF LEVEE ARE NOT SHOWN IN THIS REPORT

NOTE:
PLATE TAKEN FROM REVISED DEFINITE PROJECT REPORT, ALOHA RIGOLETTE AREA, GRANT AND RAPIDES PARISHES, LA. - JUNE 1946

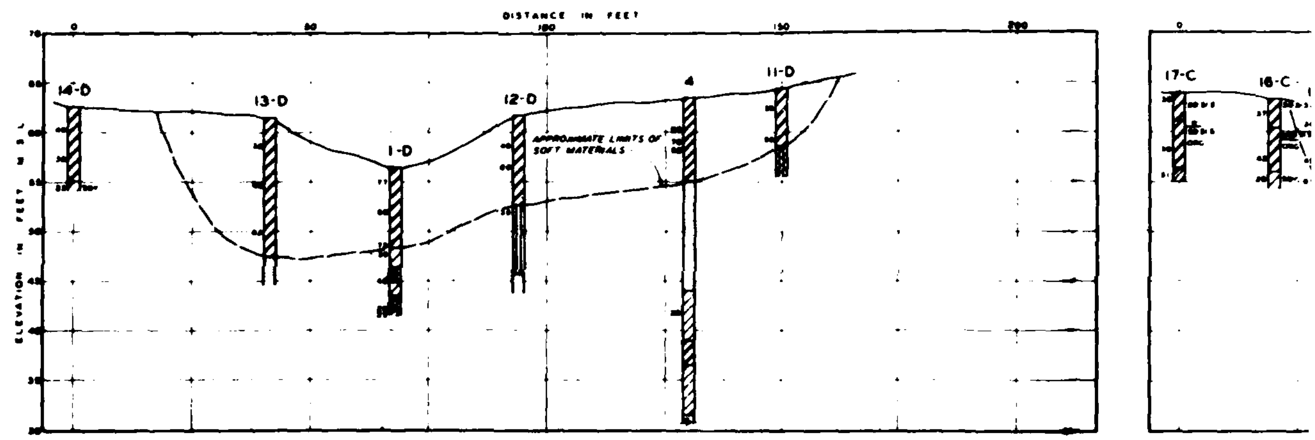
ALOHA-RIGOLETTE AREA, LOUISIANA STUDY

BAYOU RIGOLETTE FLOODGATE
PLAN OF BORINGS
BORING LOGS-BORROW AREAS A AND B

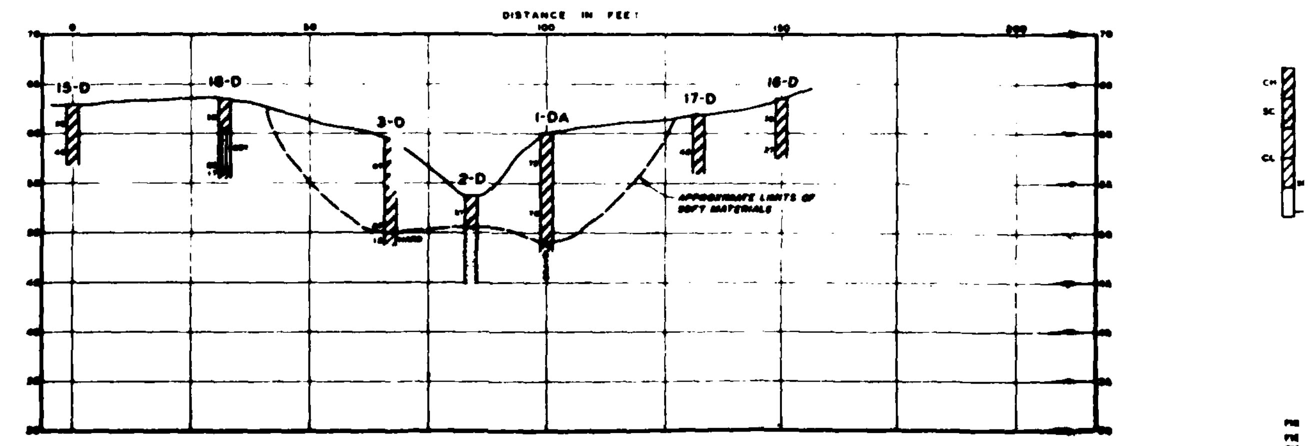
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS



SECTION 1-1



SECTION 2-2



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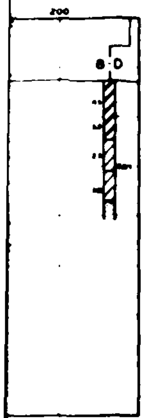
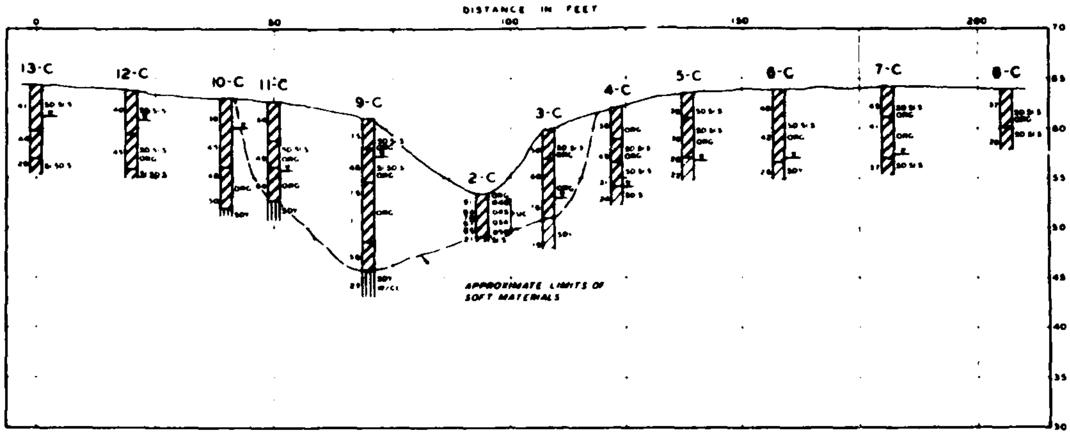
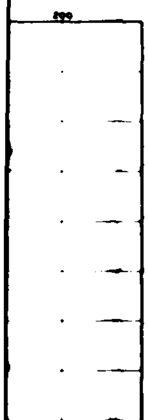
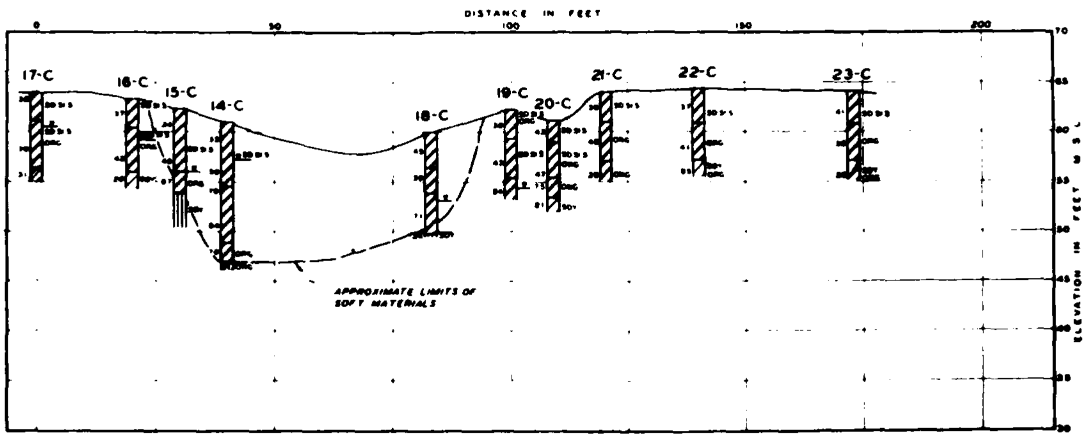


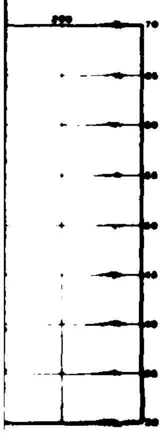


SECTION 4-4

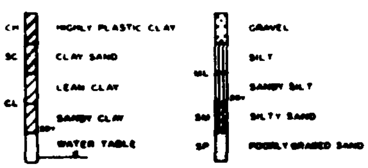




SECTION 5-5



LEGEND



ORG	ORGANIC MATTER PRESENT
SD S	THIN SAND SEAMS
SI S	THIN SILT SEAMS
SI SD S	SILTY SAND SEAMS
SD SI S	SANDY SILT SEAMS
CL S	THIN CLAY SEAMS
F	FINE
M	MEDIUM
C	COARSE
GRAV	GRAVELLY

FIGURES TO LEFT OF LOGS ARE NATURAL WATER CONTENTS. FIGURES TO RIGHT OF LOGS OF BORINGS 1-C AND 2-C ARE SHEAR STRENGTHS FROM UNCONFINED COMPRESSION TESTS (UC): COHESION IN TONS/SQ FT

Notes

All borings were drilled by the New Orleans District "D" borings were general sample borings made with an Iwan auger during the period June-September 1951

"C" borings were made in December 1951 Borings 1-C and 2-C were 3 inch undisturbed sample borings Other "C" borings were general sample borings taken with a 2-inch core barrel

Dashed line shows approximate limits of soft materials

NOTE:

PLATE TAKEN FROM REVISED
REPORT, ALOHA RIGOLETTE
RAPIDES PARISHES, LA. – JU

ALOHA-RIGOLETTE AREA

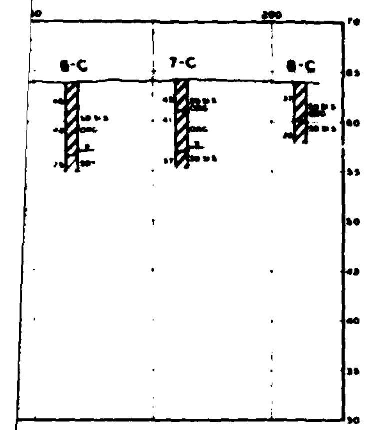
BAYOU RIGOLETT

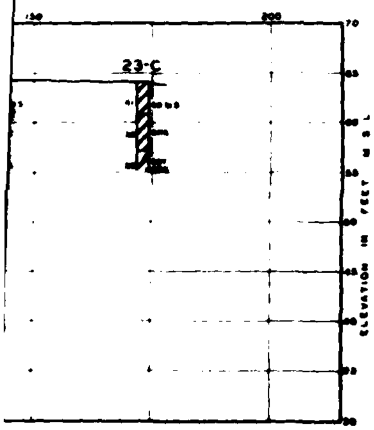
BORING

SECTIONS 1-1 T

U.S. ARMY ENGINEER DI

2





All borings were drilled by the New Orleans District
orings we:e general sample borings made with an
auger dur g the period June-September 1951
"C" borings were made in December 1951 Borings
nd 2-C were 3 inch undisturbed sample borings
r "C" borings were general sample borings taken
a 2-inch core barrel
Dashed line shows approximate limits of soft
erials

NOTE:

PLATE TAKEN FROM REVISED DEFINITE PROJECT REPORT, ALOHA RIGOLETTE AREA, GRANT AND RAPIDES PARISHES, LA. – JUNE 1946

ALOHA-RIGOLETTE AREA, LOUISIANA STUDY

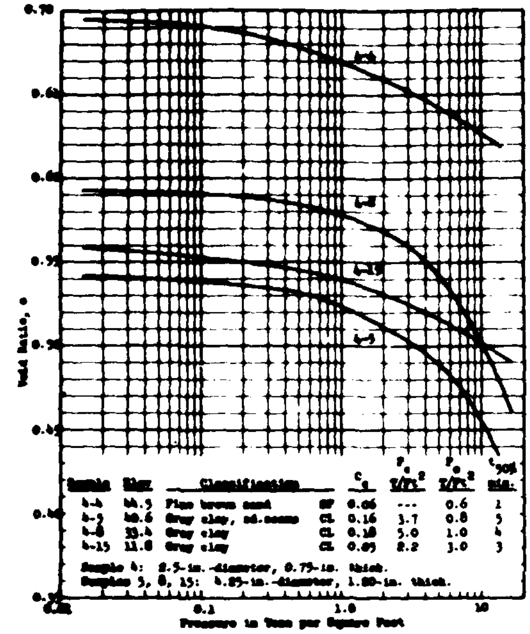
BAYOU RIGOLETTE FLOODGATE

BORING LOGS

SECTIONS 1-1 THROUGH 5.5

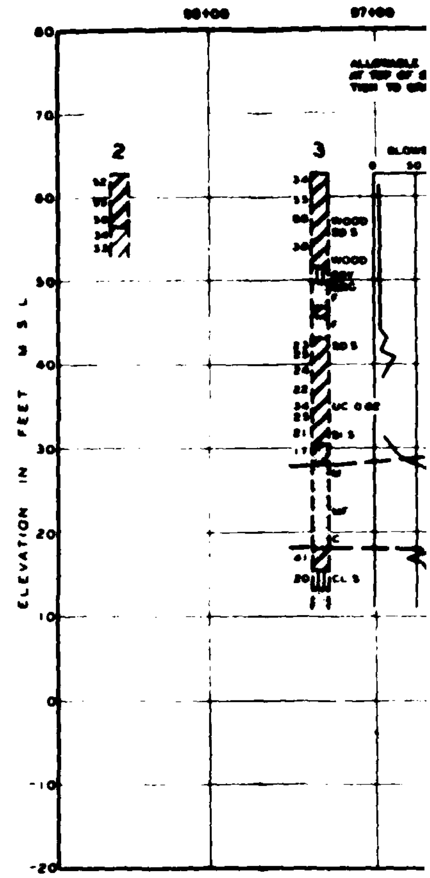
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

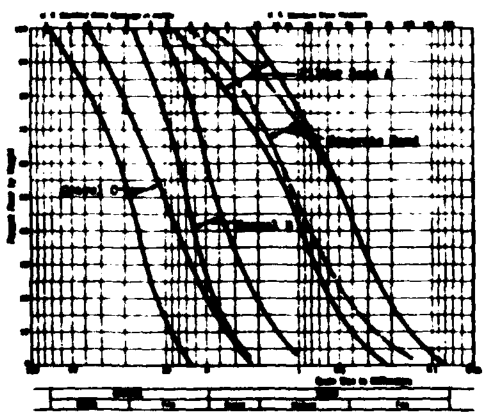
③



PRESSURE - VOID RATIO CURVES

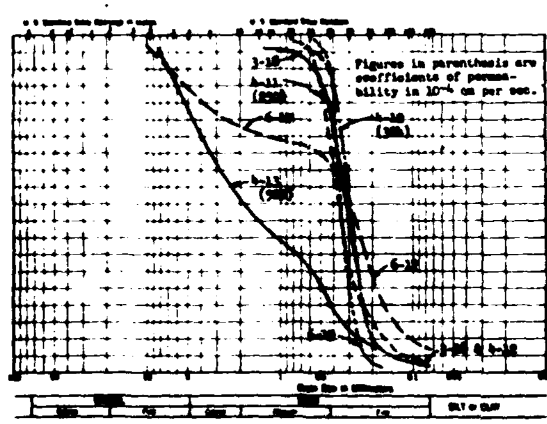
CONSOLIDATION TESTS





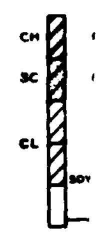
GRADATION LIMITS

FILTER MATERIALS



GRAIN SIZE CURVES

FOUNDATION SANDS



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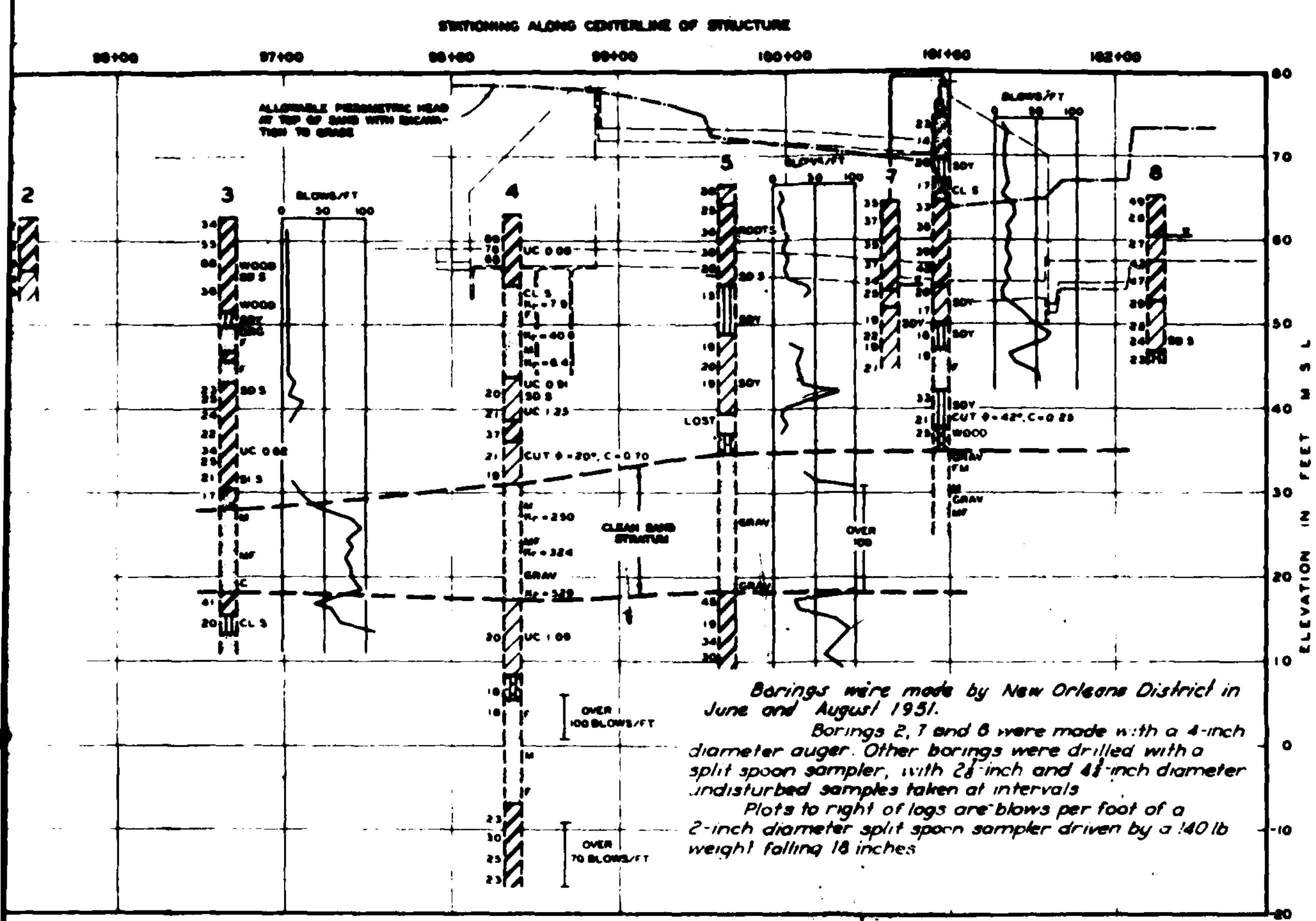
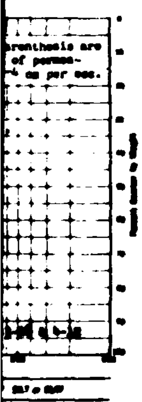
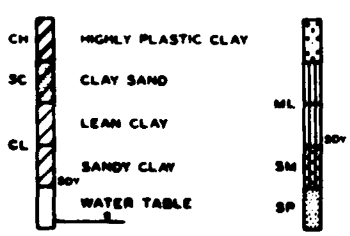


PROFILE ALONG CENTER LINE OF STRUCTURE



LEGEND



CH	HIGHLY PLASTIC CLAY		GRAVEL
SC	CLAY SAND		SILT
CL	LEAN CLAY	ML	SANDY SILT
	SANDY CLAY	SM	SILTY SAND
	WATER TABLE	SP	POORLY GRADED SAND

ORG	ORGANIC MATTER PRESENT
SD S	THIN SAND SEAMS
SI S	THIN SILT SEAMS
SI SD S	SILTY SAND SEAMS
SD SI S	SANDY SILT SEAMS
CL S	THIN CLAY SEAMS
F	FINE
M	MEDIUM
C	COARSE
GRAV	GRAVELLY

FIGURES TO LEFT OF LOGS ARE NATURAL WATER CONTENTS

FIGURES TO RIGHT OF LOGS ARE SHEAR STRENGTH AND PERMEABILITY:

- UC. UNCONFINED COMPRESSION TEST; COHESION IN TONS/SQ FT
- CUT CONSOLIDATED-UNDRAINED TRIAXIAL TEST: Φ IN DEGREES, COHESION IN TONS/SQ FT
- K_r COEFFICIENT OF PERMEABILITY OF REMOLDED SAMPLE IN 10^{-4} CM/SEC

NOTE:

PLATE TAKEN FROM
REPORT, ALOHA RI
RAPIDES PARISHES

ALOHA-RIGO

BAYOU RIG

ON STRU
TE

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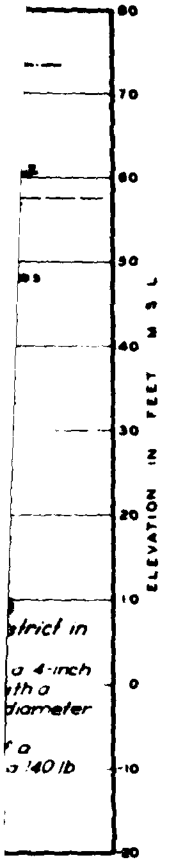


WATER CONTENTS
STRENGTH AND

T; COHESION IN

IAXIAL TEST: Φ IN
Q FT

OF REMOLDED

NOTE:

PLATE TAKEN FROM REVISED DEFINITE PROJECT REPORT, ALOHA RIGOLETTE AREA, GRANT AND RAPIDES PARISHES, LA. – JUNE 1946

ALOHA-RIGOLETTE AREA, LOUISIANA STUDY

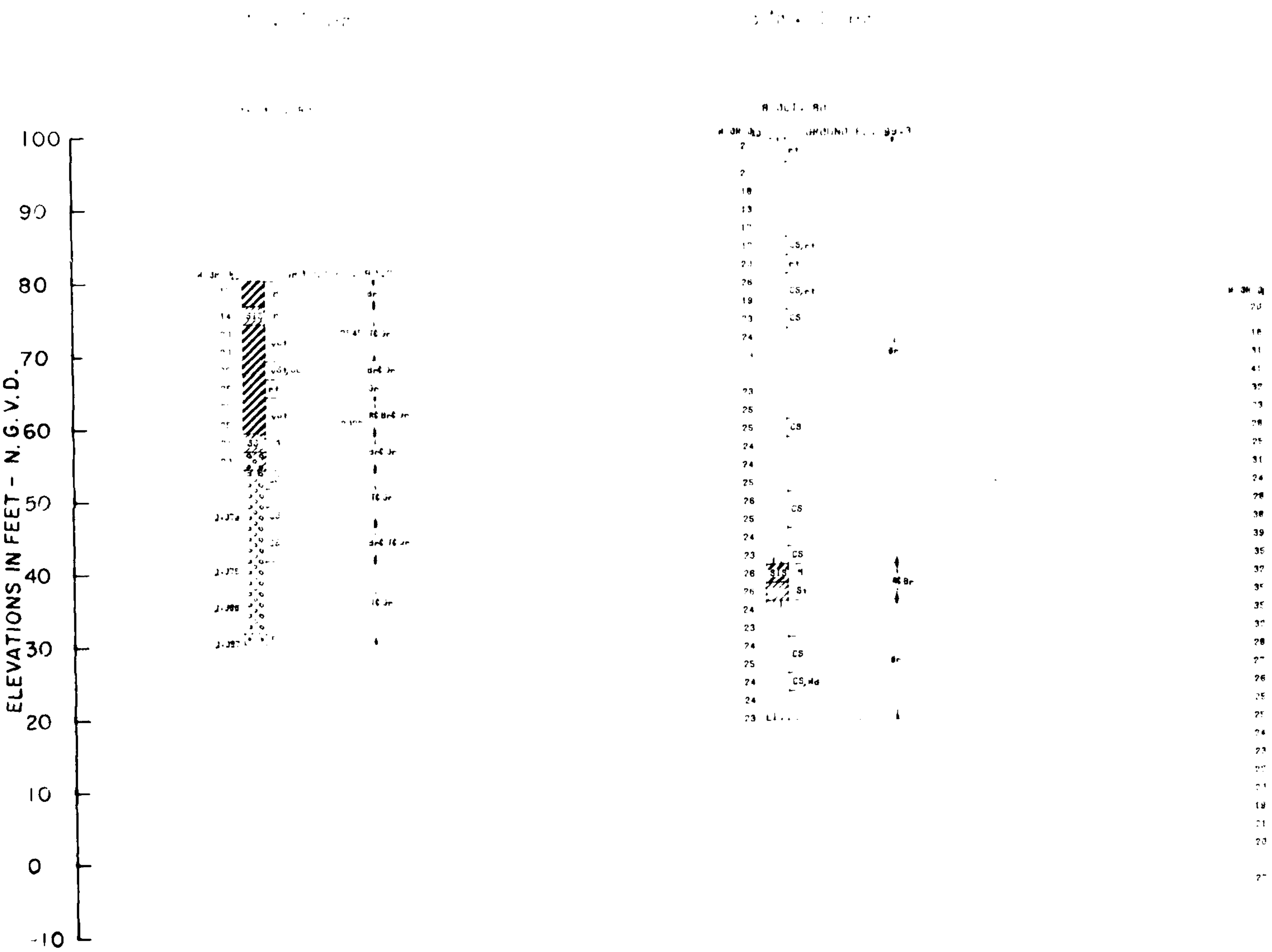
BAYOU RIGOLETTE FLOODGATE

BORING LOGS

ON STRUCTURE CENTERLINE

TEST DATA PLOTS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

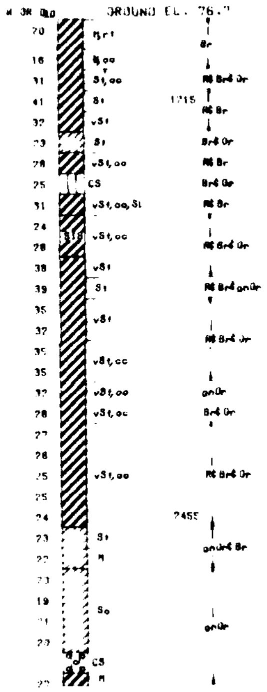


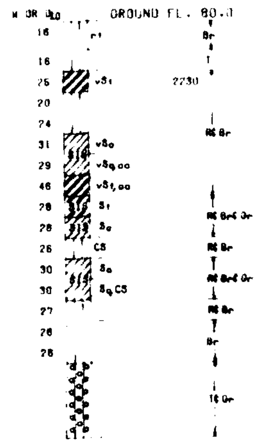
NOTE S[illegible]E OF BORINGS

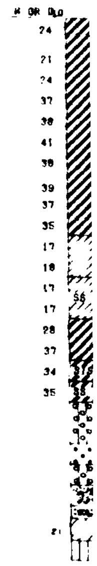
1-AR On Buyou Rigolette at Grant-Rapides Parish Line
2 AR Mouth of Bayou Darrow
3 AR Juncture of Sandy Bayou and Bayou Darrow
4 AR Between Sam Bayou and Red River Levee
5-AR At Ia[illegible] Lake Dam

BOR. 4 HR

9 OCT. 80







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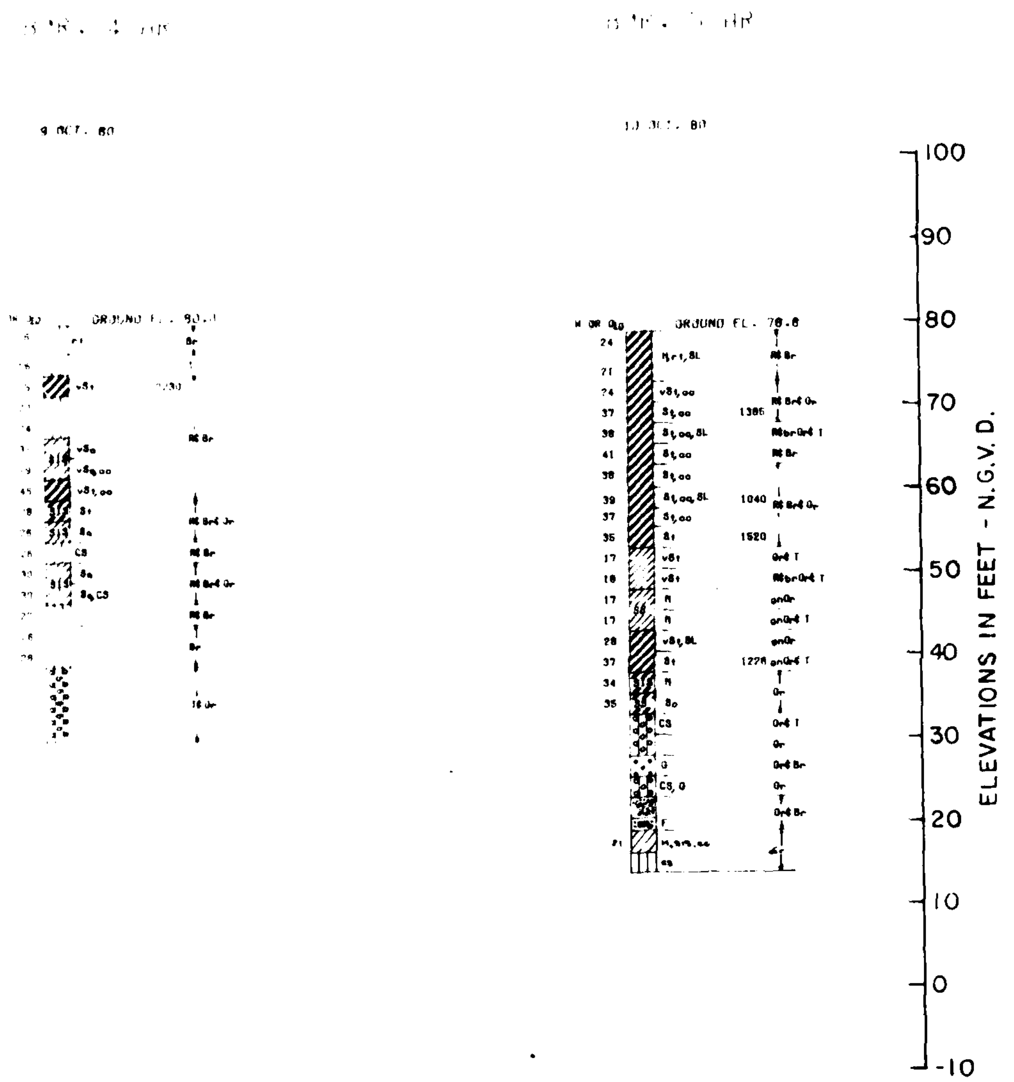
U.S.



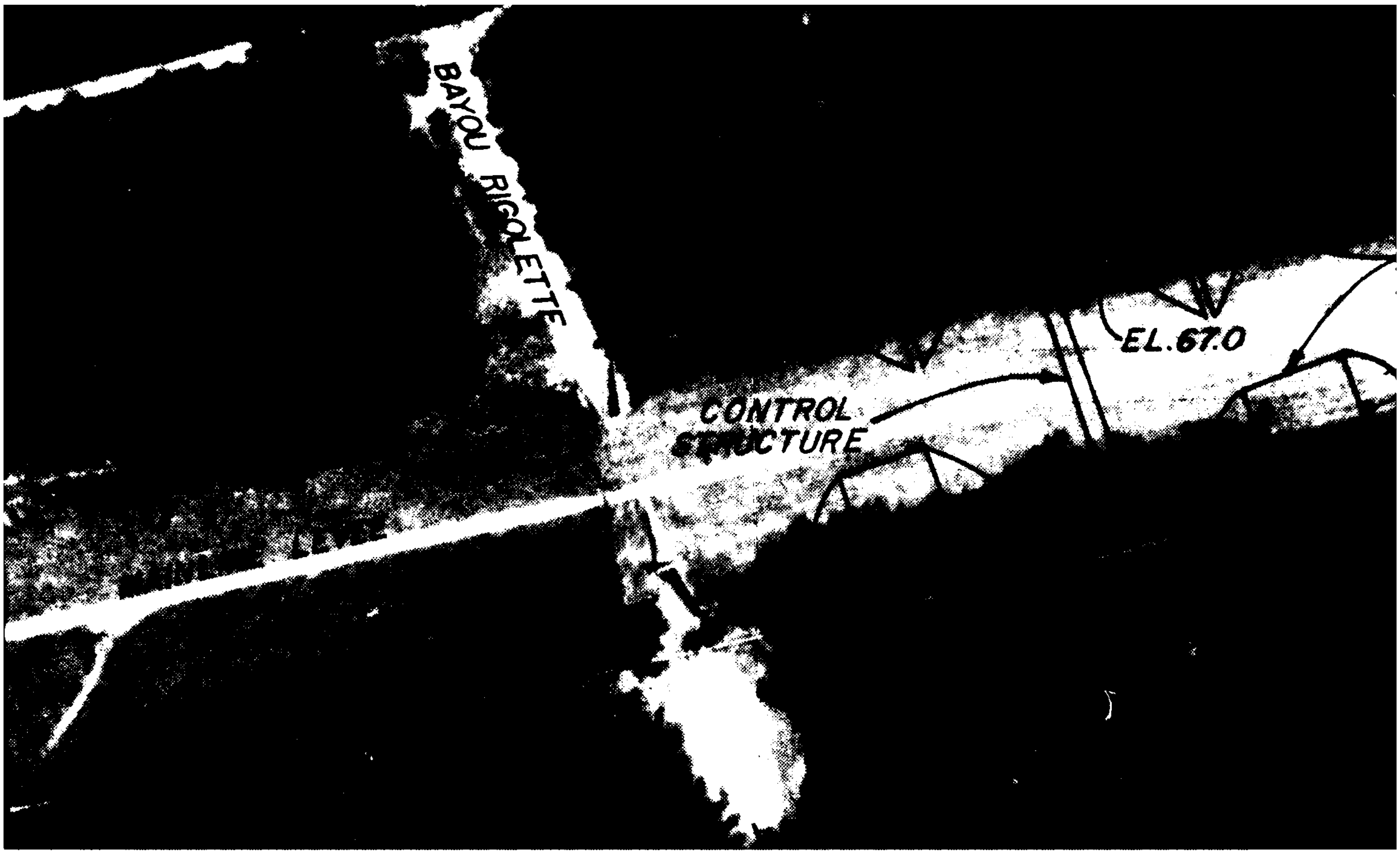
ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

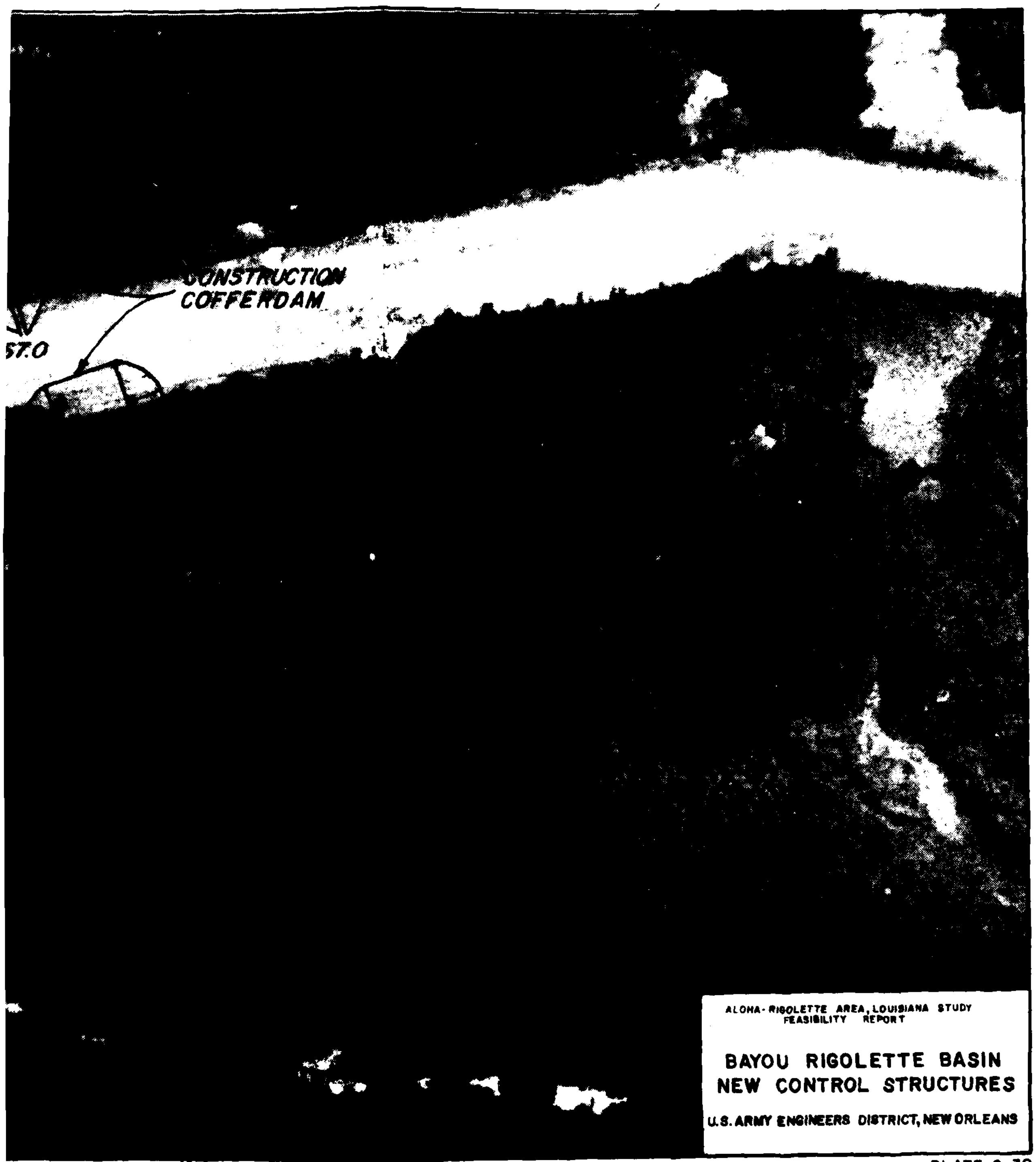
SOIL BORINGS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-29

(3)


BAYOU RIGOLETTE
CONTROL STRUCTURE
EL.67.0

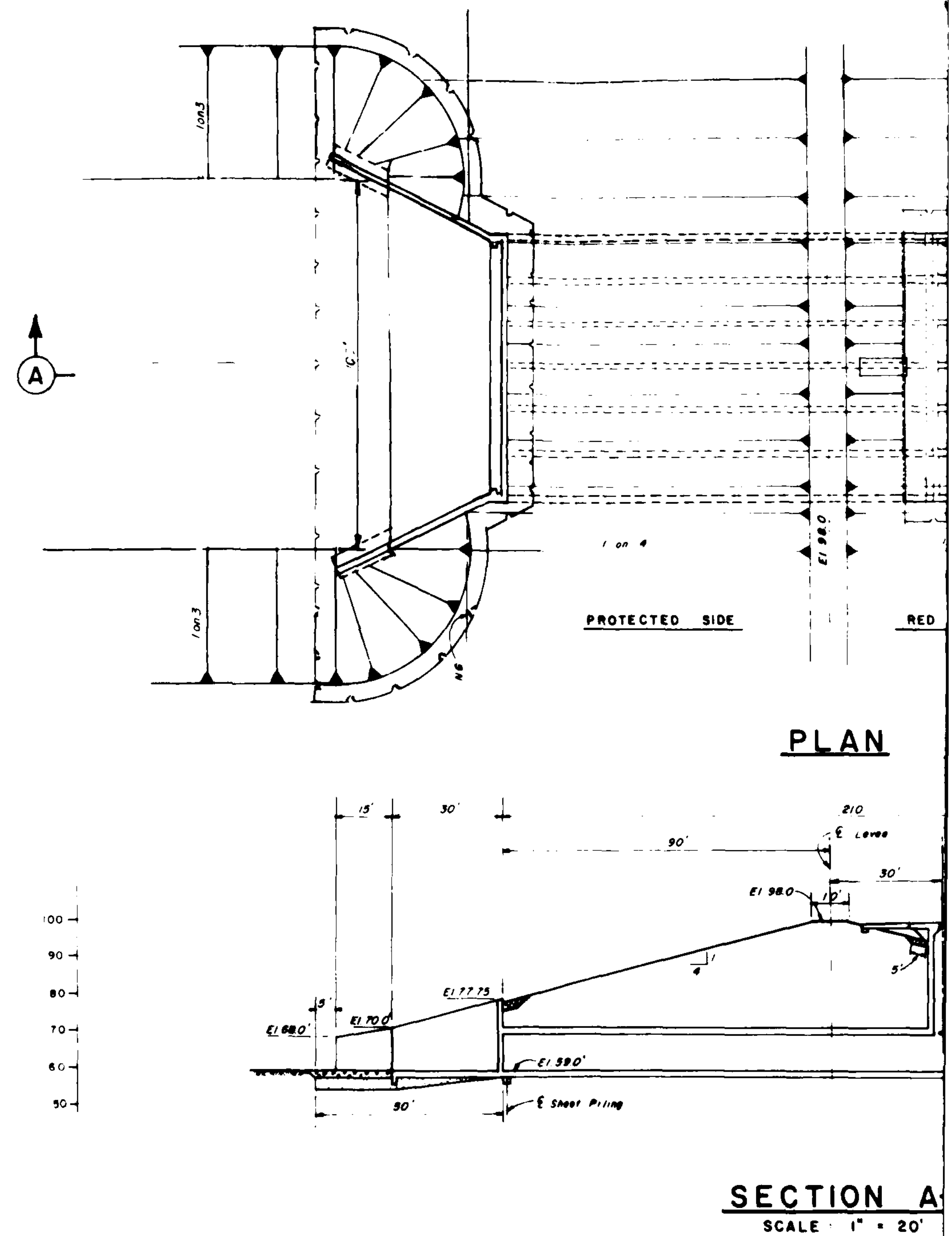


ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

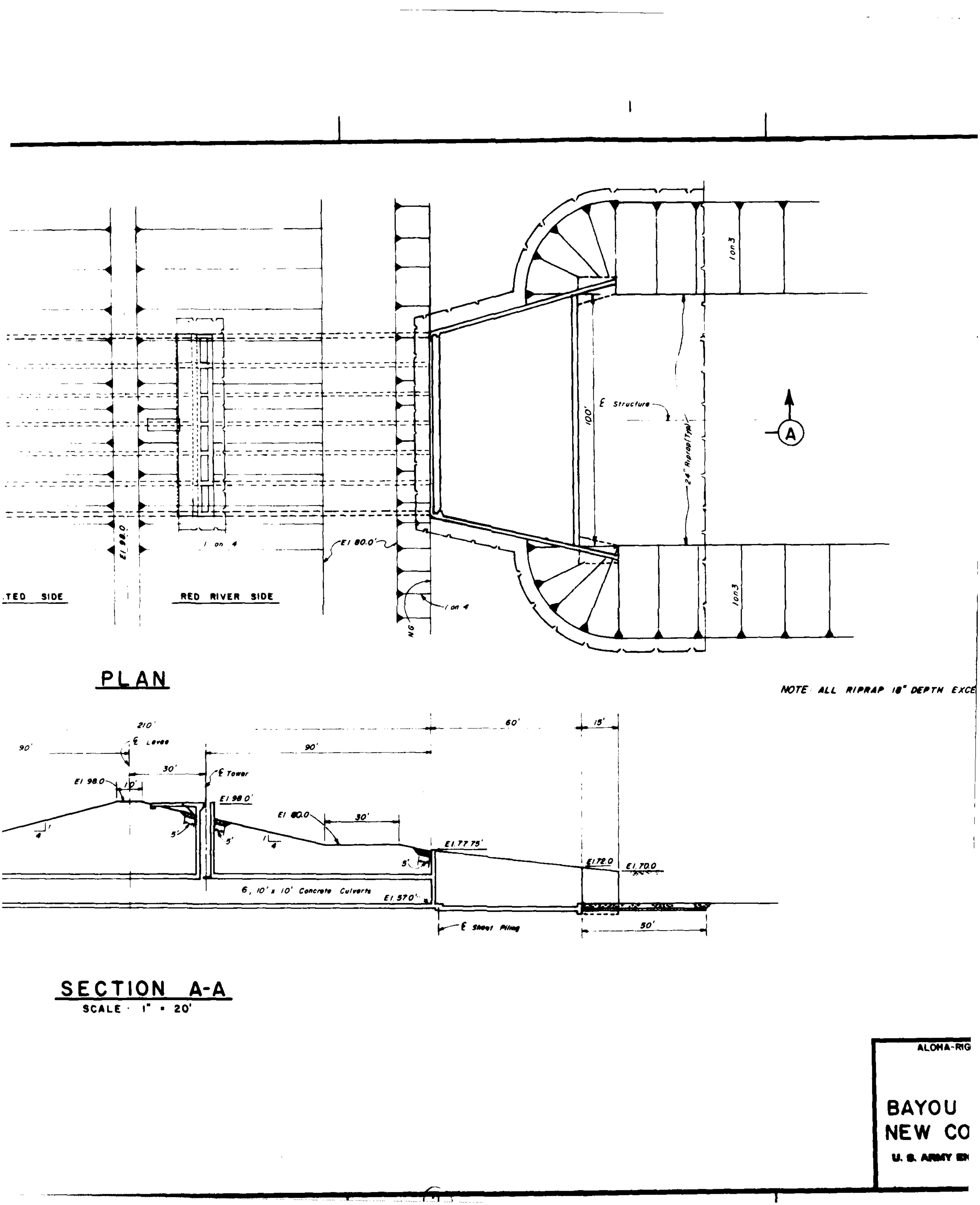
BAYOU RIGOLETTE BASIN
NEW CONTROL STRUCTURES

U.S. ARMY ENGINEERS DISTRICT, NEW ORLEANS

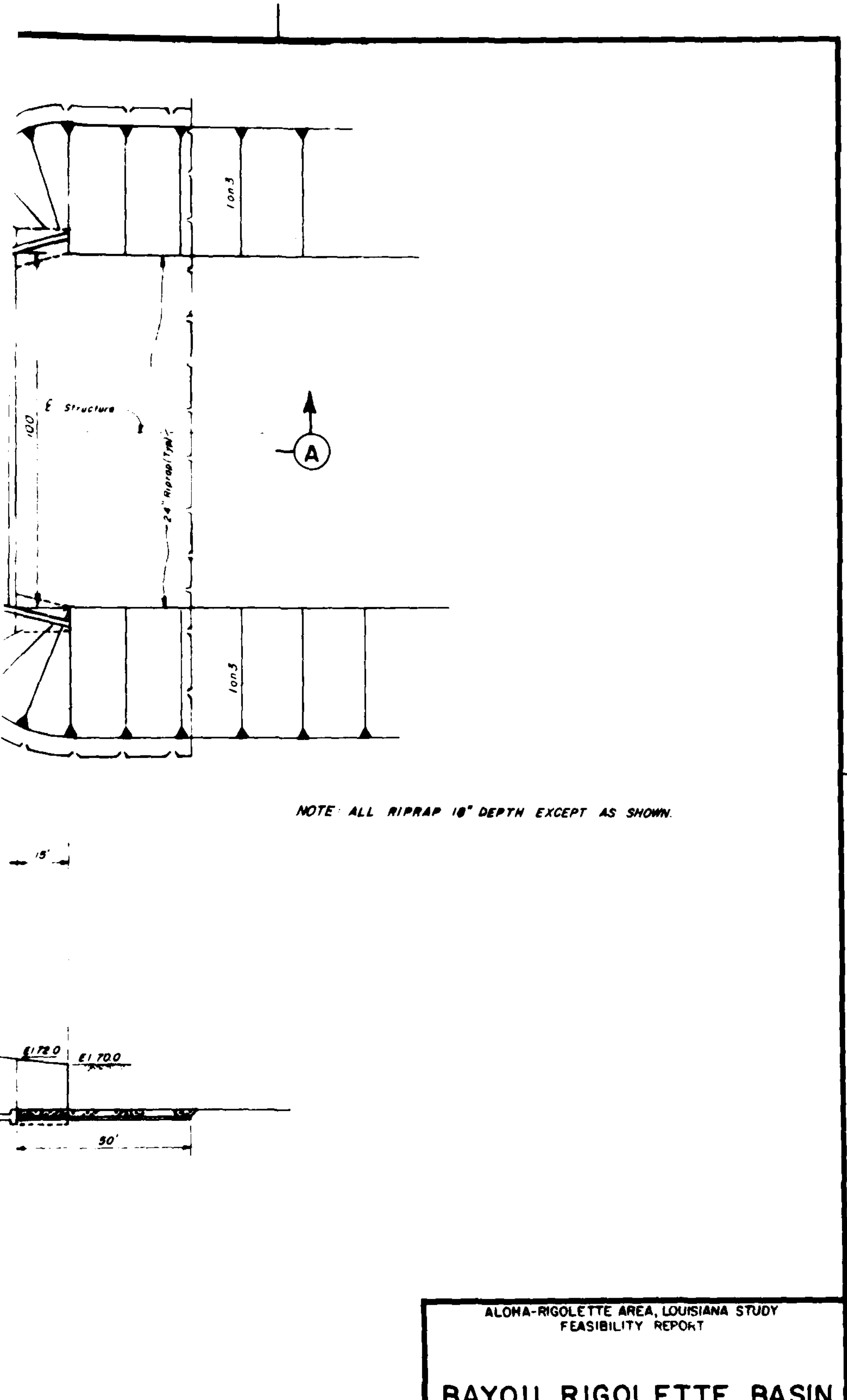
PLATE C-30



1 on 3
A
1 on 4
El 98.0
PROTECTED SIDE
RED
1 on 3
PLAN
15'
30'
210
℄ Levee
90'
30'
El 98.0
10'
100
90
80
70
60
50
1
4
5'
El 77.75
5'
El 70.0'
El 68.0'
El 59.0'
30'
℄ Sheet Piling
SECTION A
SCALE 1" = 20'



PLAN
SECTION A-A
SCALE · 1" = 20'
TED SIDE
RED RIVER SIDE
El 98.0
1 on 4
El 80.0'
N G
1 on 4
100'
℄ Structure
24" Riprap (Typ)
1 on 3
1 on 3
A
NOTE: ALL RIPRAP 18" DEPTH EXCE
210'
90'
℄ Levee
90'
60'
15'
30'
℄ Tower
El 98.0
10'
El 98.0'
El 80.0
30'
5'
5'
El 77.75'
5'
El 72.0
El 70.0
6, 10' x 10' Concrete Culverts
El 57.0'
℄ Sheet Piling
50'
ALOHA-RIG
BAYOU
NEW CO
U. S. ARMY EN

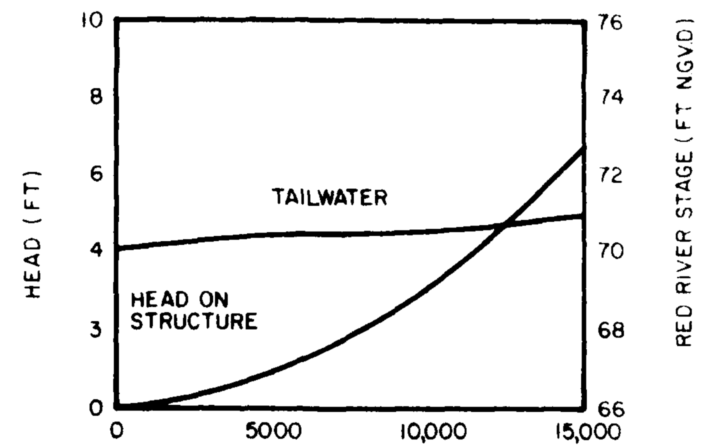


ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

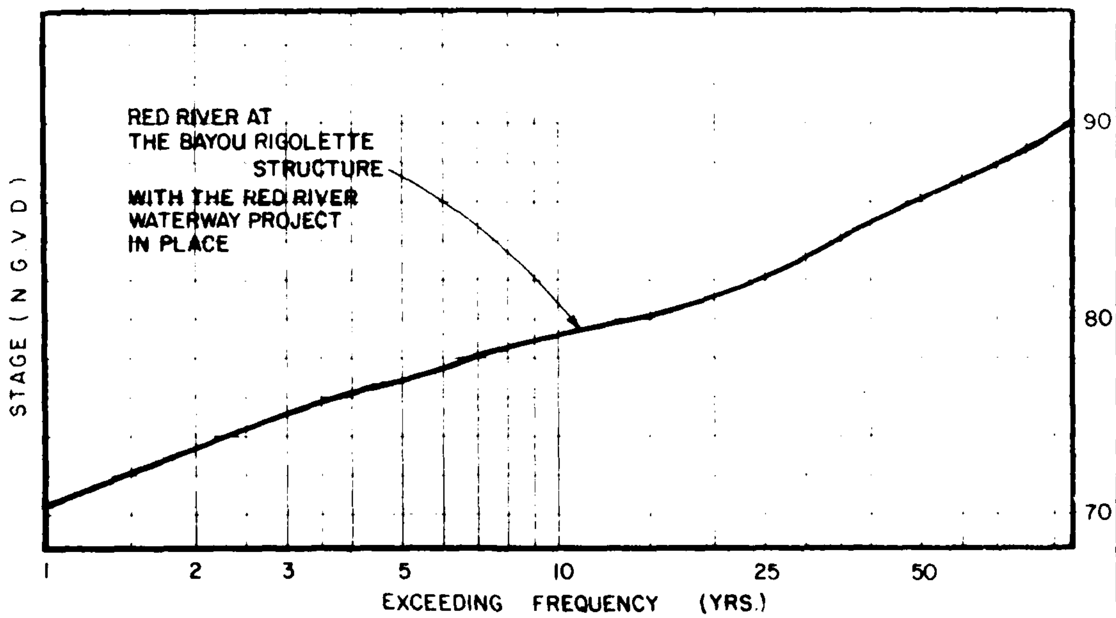
BAYOU RIGOLETTE BASIN NEW CONTROL STRUCTURE

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS

3



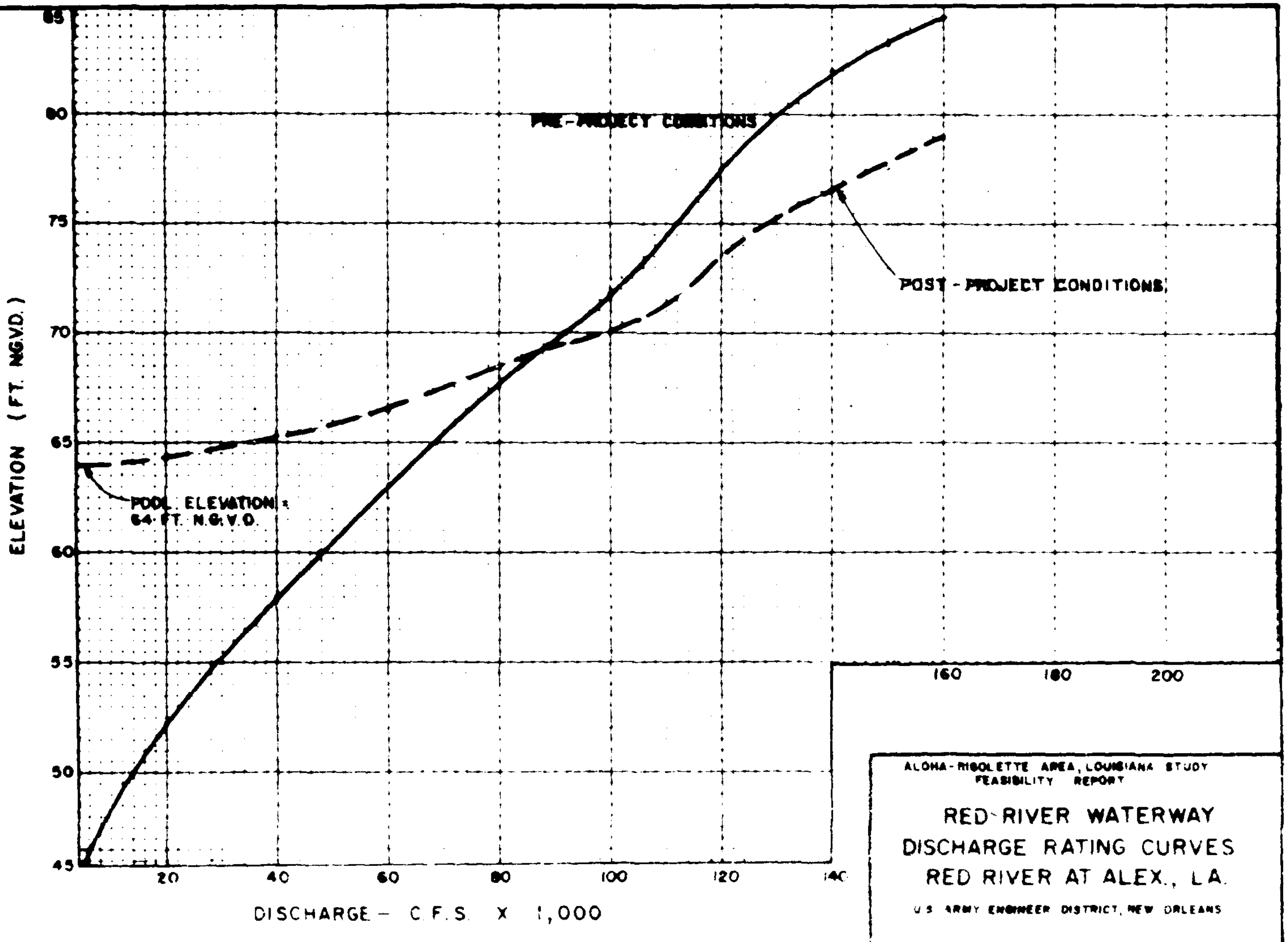
8-10'X10' FLOODGATES
STRUCTURE RATING CURVES



ALOHA - RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

ALOHA–RIGOLETTE SELECTED PLAN DESIGN CURVES

U S ARMY ENGINEER DISTRICT, NEW ORLEANS

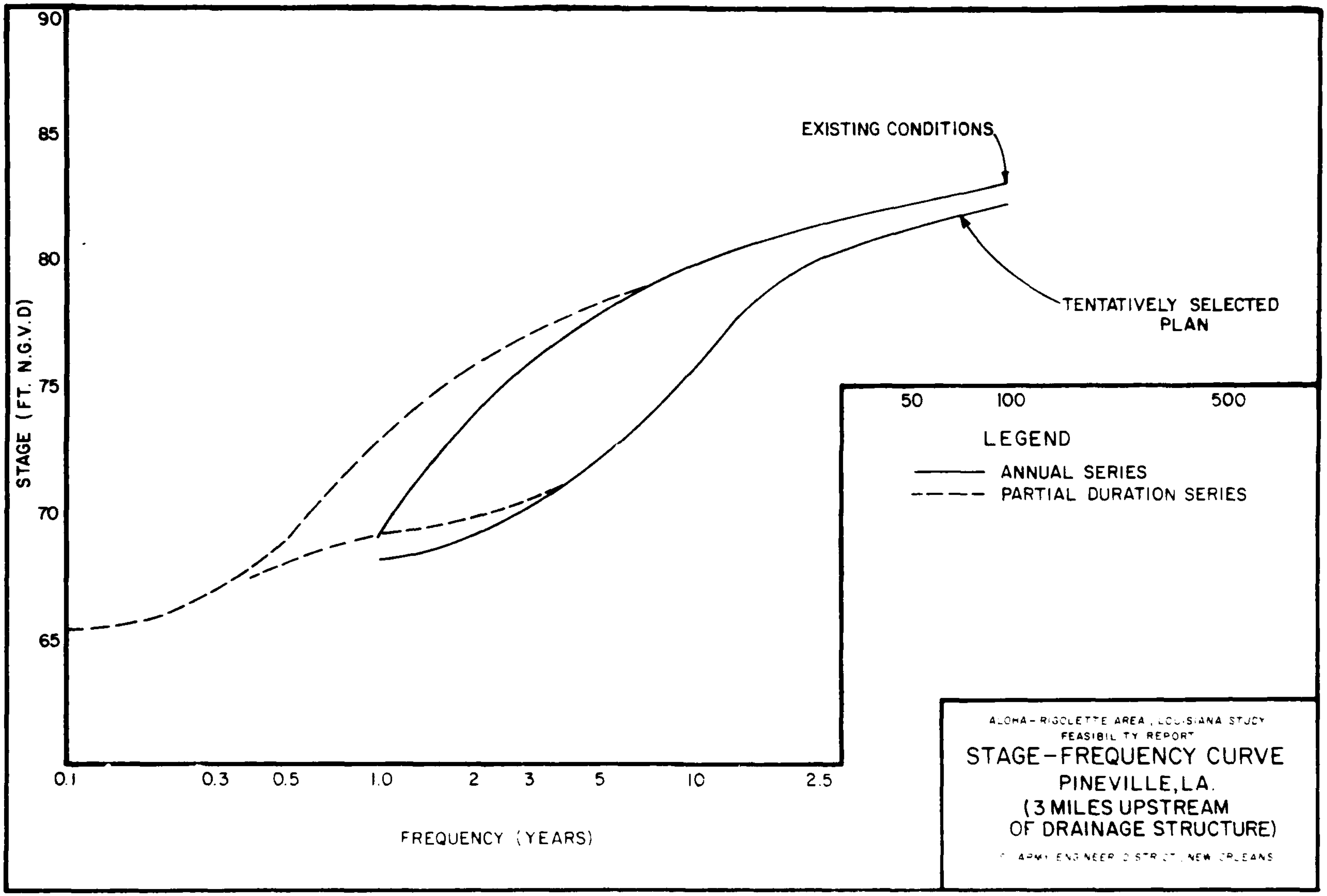


ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

RED RIVER WATERWAY
DISCHARGE RATING CURVES
RED RIVER AT ALEX., LA.

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-33

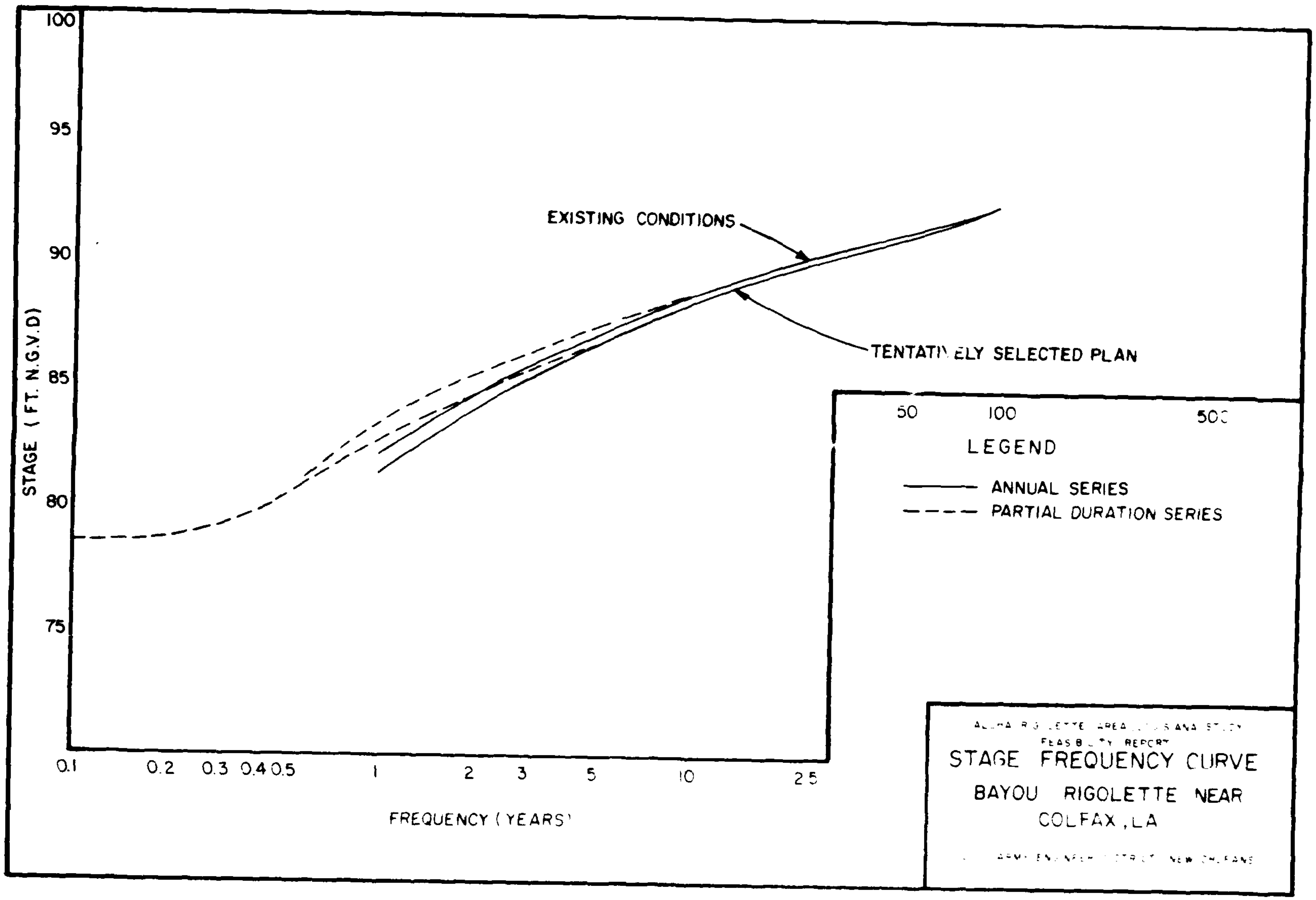


ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STAGE-FREQUENCY CURVE
PINEVILLE, LA.
(3 MILES UPSTREAM
OF DRAINAGE STRUCTURE)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-34



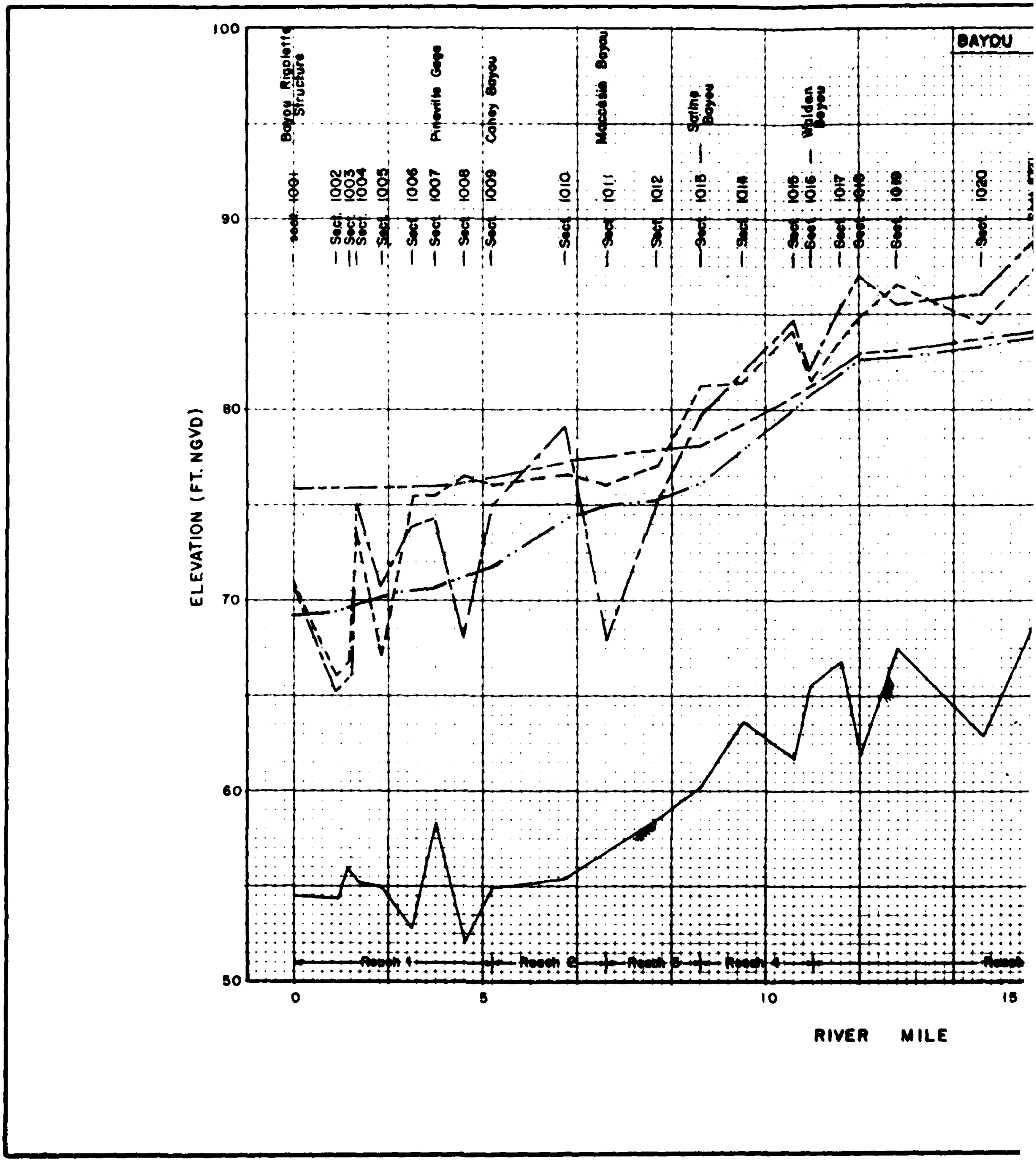
FEASIBILITY REPORT

STAGE FREQUENCY CURVE

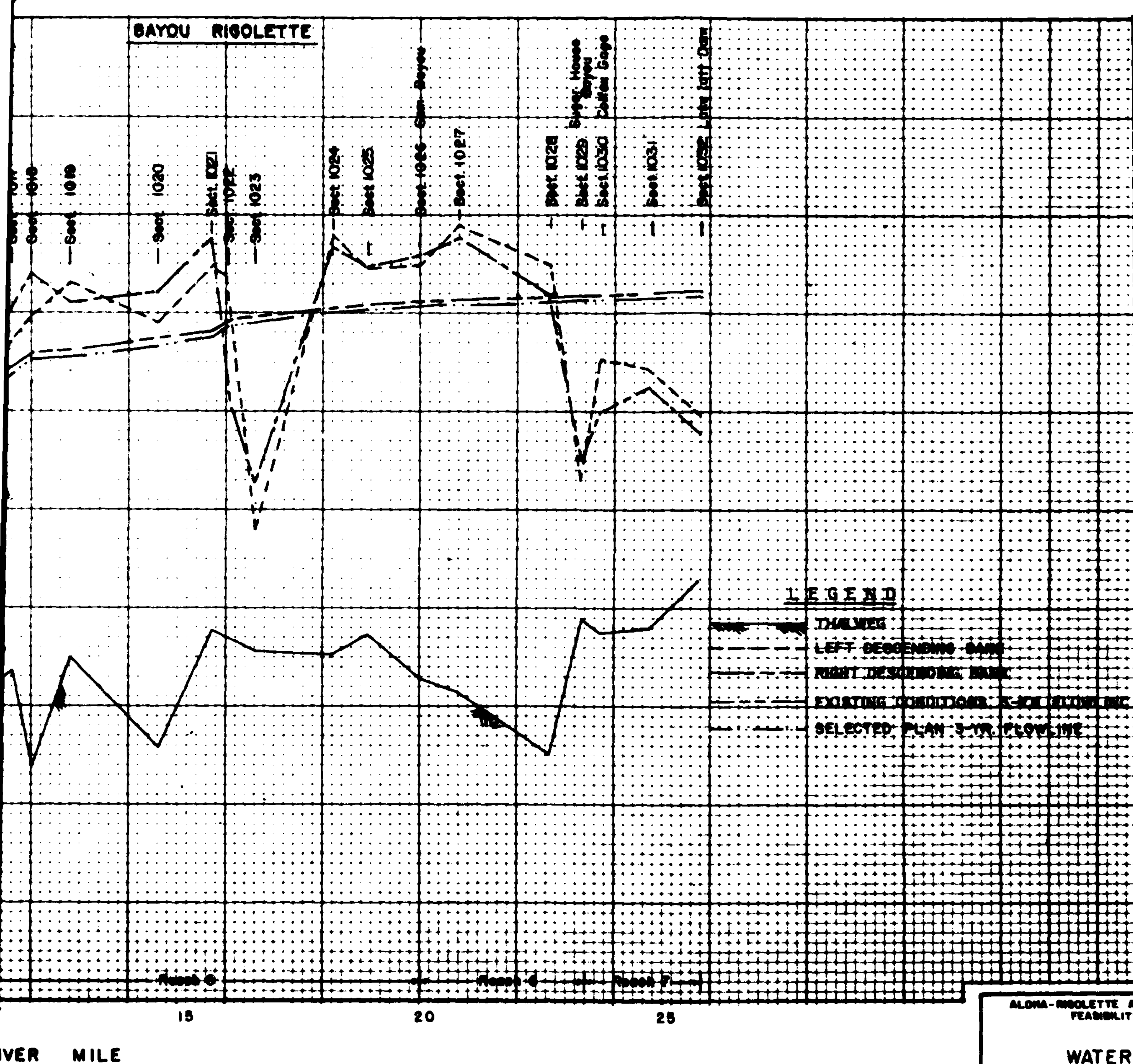
BAYOU RIGOLETTE NEAR COLFAX, LA

ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE


BAYOU
ELEVATION (FT. NGVD)
RIVER MILE
100
90
80
70
60
50
0
5
10
15
Bayou Rigolette Structure
Pineville Gage
Cahey Bayou
Moccasin Bayou
Saline Bayou
Walden Bayou
Sect. 1001
Sect. 1002
Sect. 1003
Sect. 1004
Sect. 1005
Sect. 1006
Sect. 1007
Sect. 1008
Sect. 1009
Sect. 1010
Sect. 1011
Sect. 1012
Sect. 1013
Sect. 1014
Sect. 1015
Sect. 1016
Sect. 1017
Sect. 1018
Sect. 1019
Sect. 1020
Reach 1
Reach 2
Reach 3
Reach 4

(1)

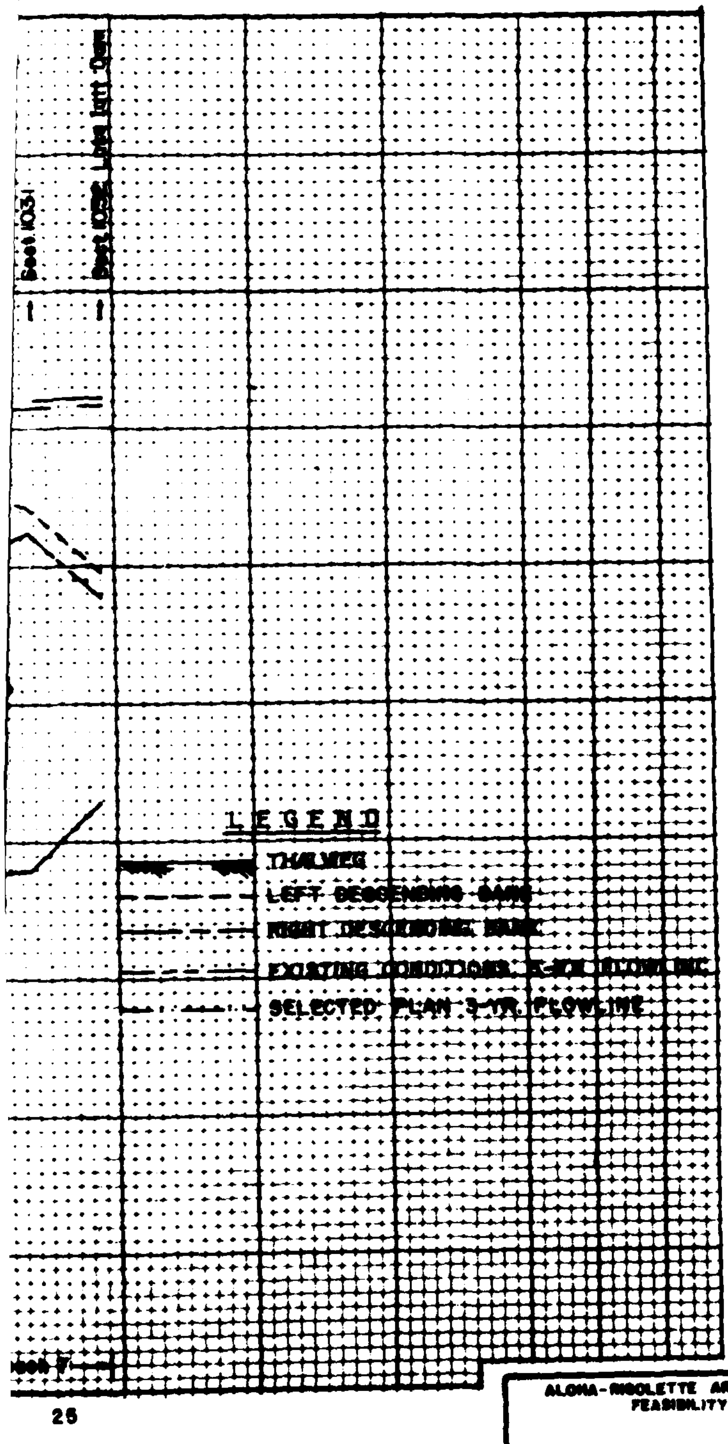


ALOHA-RIGOLETTE AR
FEASIBILITY

WATER
3-YR

U.S. ARMY ENGINEER

2



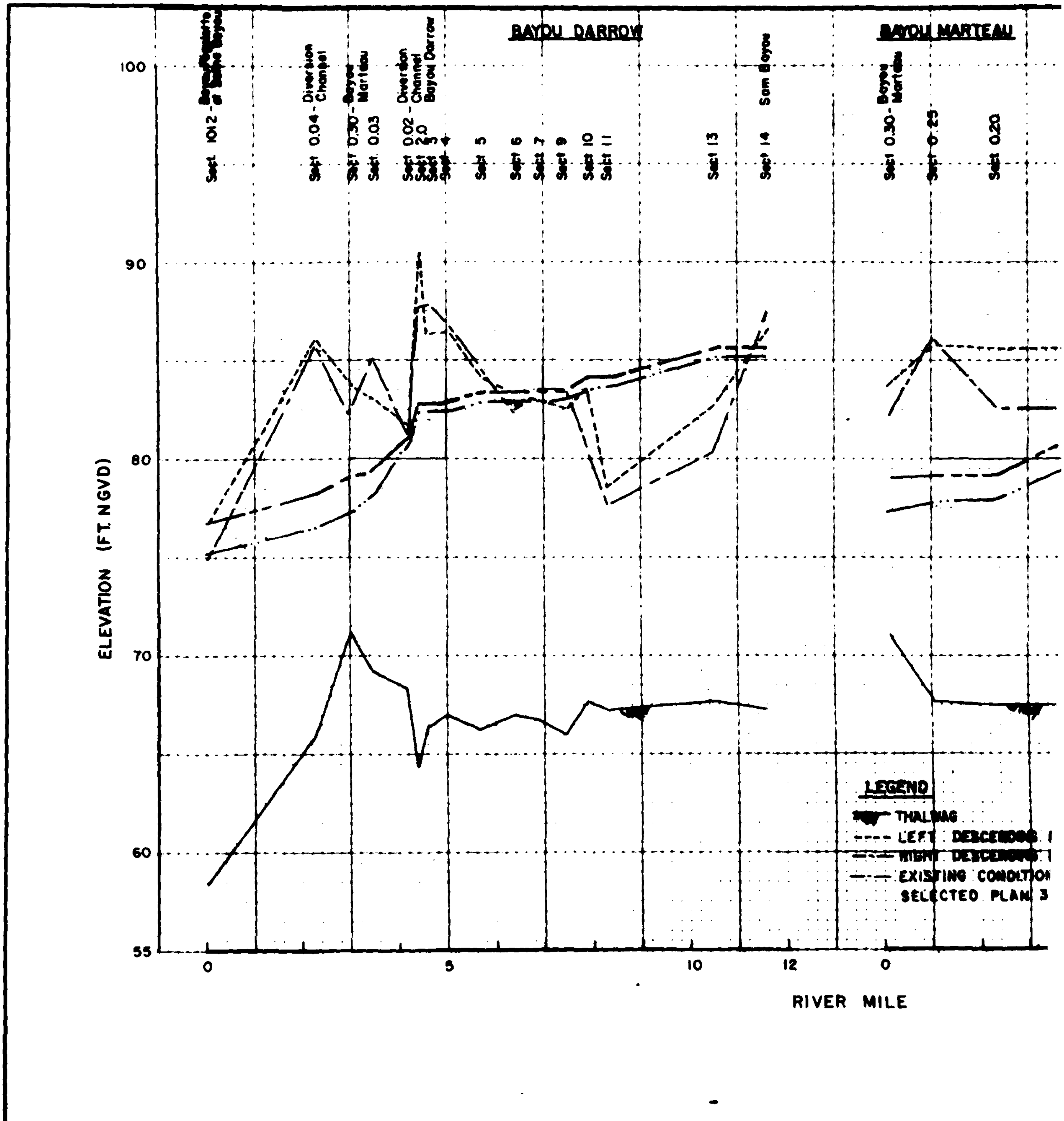
ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

WATER SURFACE
3-YR FLOWLINE

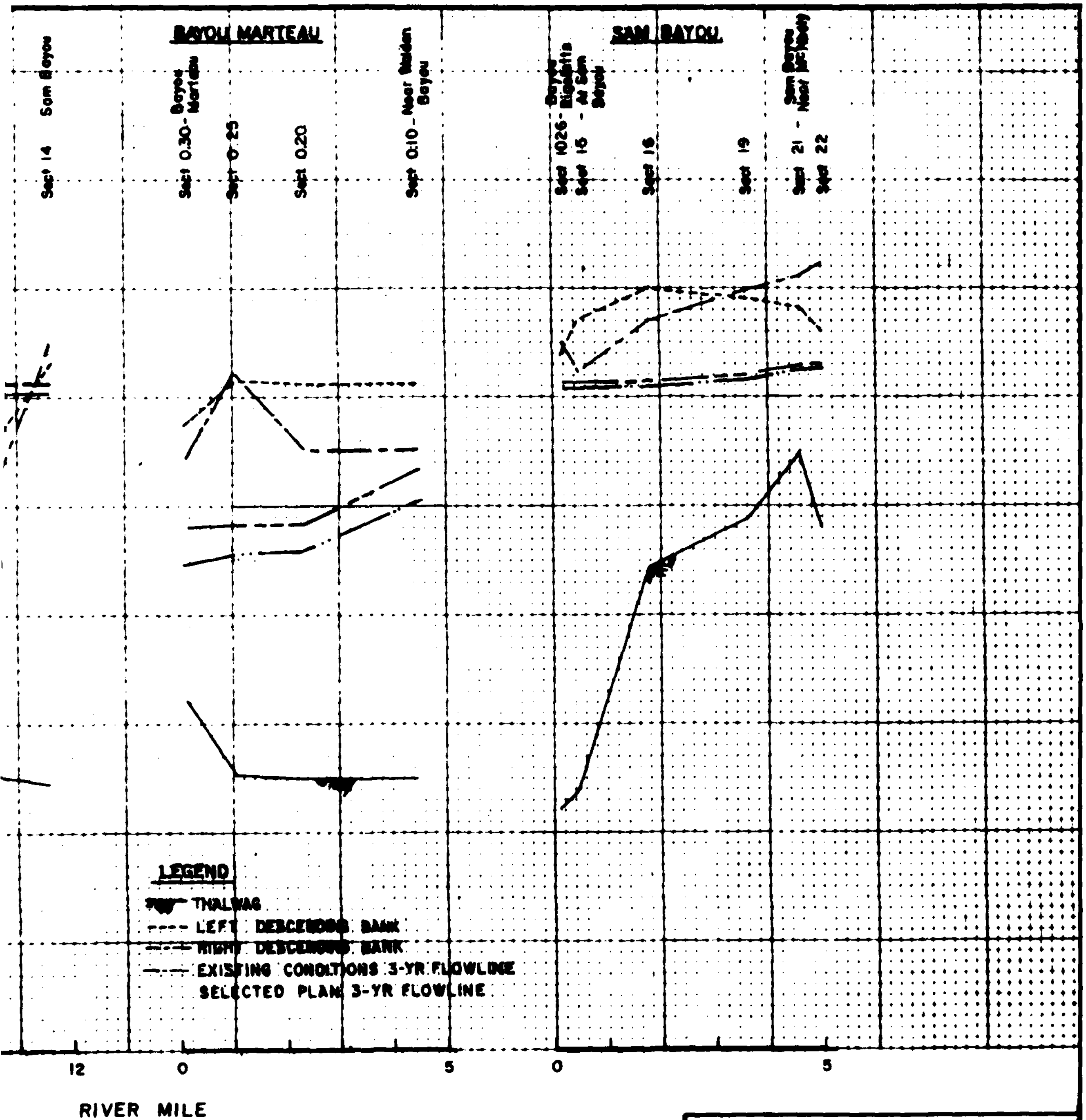
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-36

(3)



BAYOU DARROW
BAYOU MARTEAU
Sect 1012 - Bayou Marteau at Bayou
Sect 0.04 - Diversion Channel
Sect 0.30 - Bayou Marteau
Sect 0.03
Sect 0.02 - Diversion Channel Bayou Darrow
Sect 2.0
Sect 3
Sect 4
Sect 5
Sect 6
Sect 7
Sect 9
Sect 10
Sect 11
Sect 13
Sect 14 Sam Bayou
Sect 0.30 - Bayou Marteau
Sect 0.25
Sect 0.20
ELEVATION (FT. NGVD)
100
90
80
70
60
55
0
5
10
12
0
RIVER MILE
LEGEND
THALWAG
LEFT DESCENDING
RIGHT DESCENDING
EXISTING CONDITION
SELECTED PLAN 3

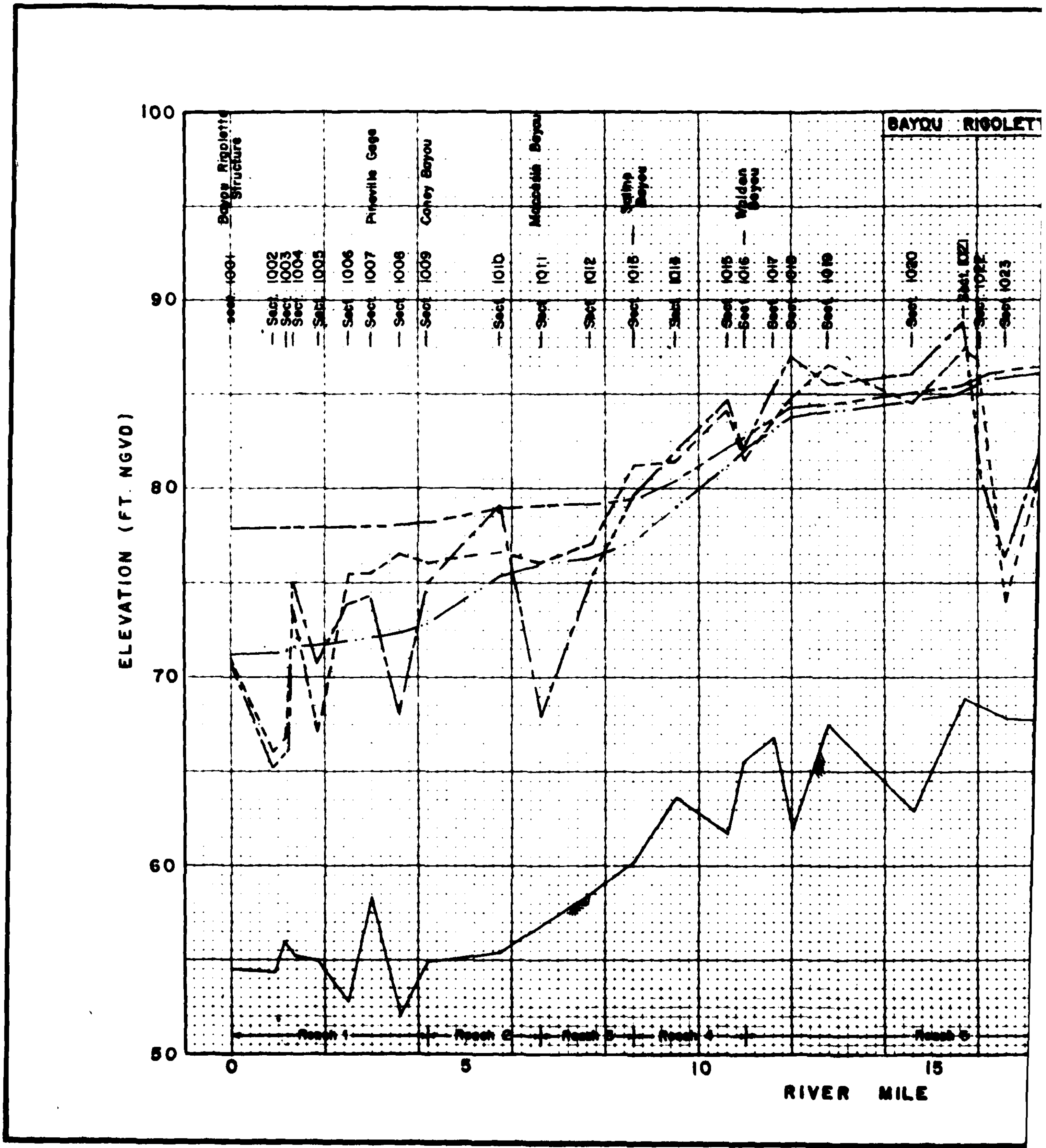


ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

WATER SURFACE
3-YR FLOWLINE

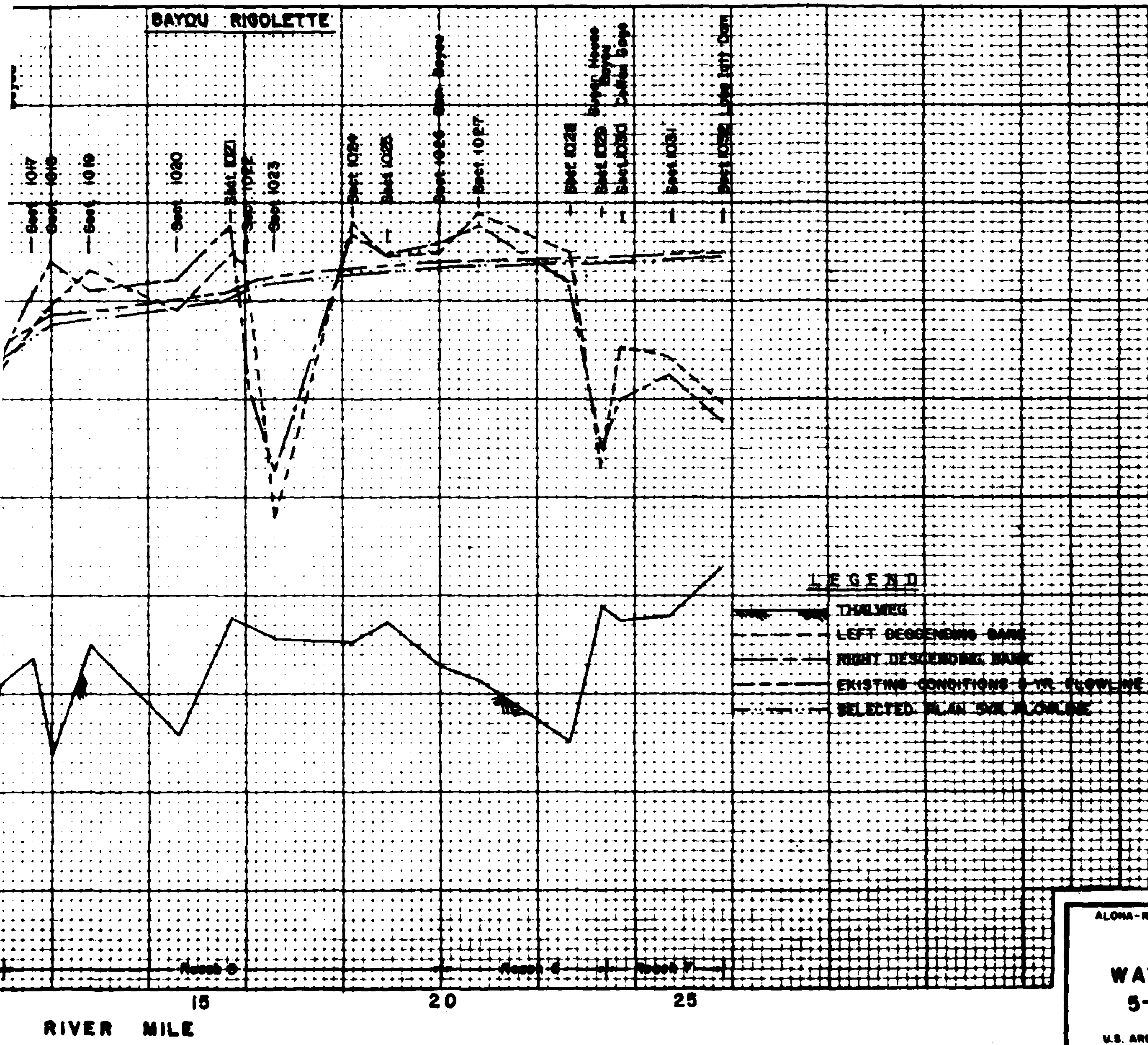
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-37



BAYOU RIGOLETT
ELEVATION (FT. NGVD)
RIVER MILE
Bayou Rigolette Structure
Pineville Gage
Coney Bayou
Mcnabb Bayou
Saline Bayou
Walden Bayou
Sec. 1001
Sec. 1002
Sec. 1003
Sec. 1004
Sec. 1005
Sec. 1006
Sec. 1007
Sec. 1008
Sec. 1009
Sec. 1010
Sec. 1011
Sec. 1012
Sec. 1013
Sec. 1014
Sec. 1015
Sec. 1016
Sec. 1017
Sec. 1018
Sec. 1019
Sec. 1020
Sec. 1022
Sec. 1023
Reach 1
Reach 2
Reach 3
Reach 4
Reach 5
100
90
80
70
60
50
0
5
10
15

(1).



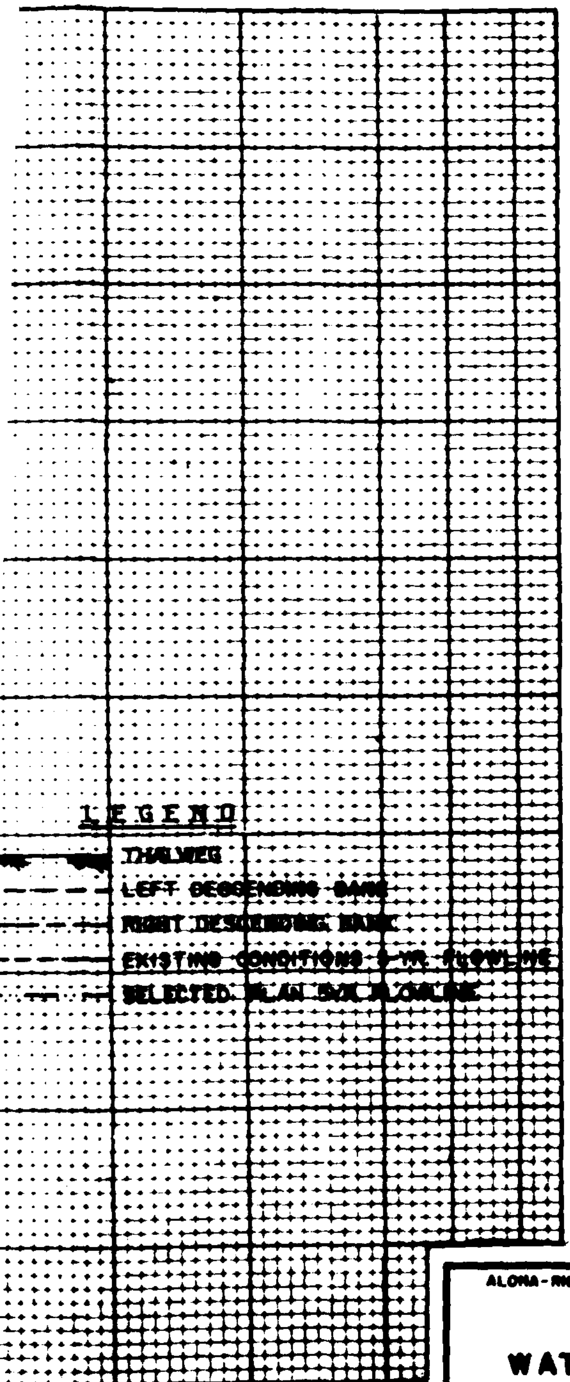
ALOHA-RI

WAT

5-

U.S. ARM

2



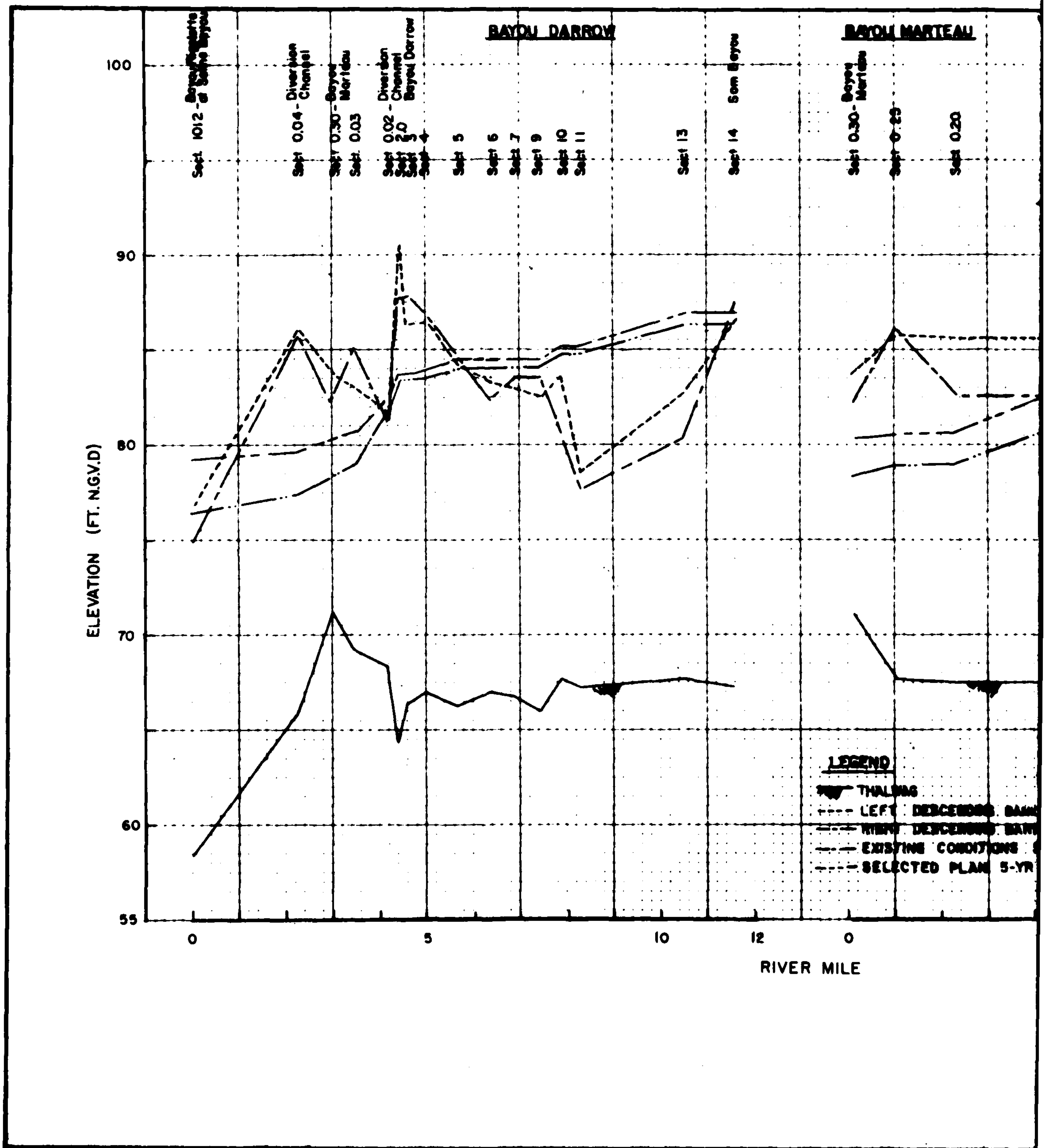
ALONA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

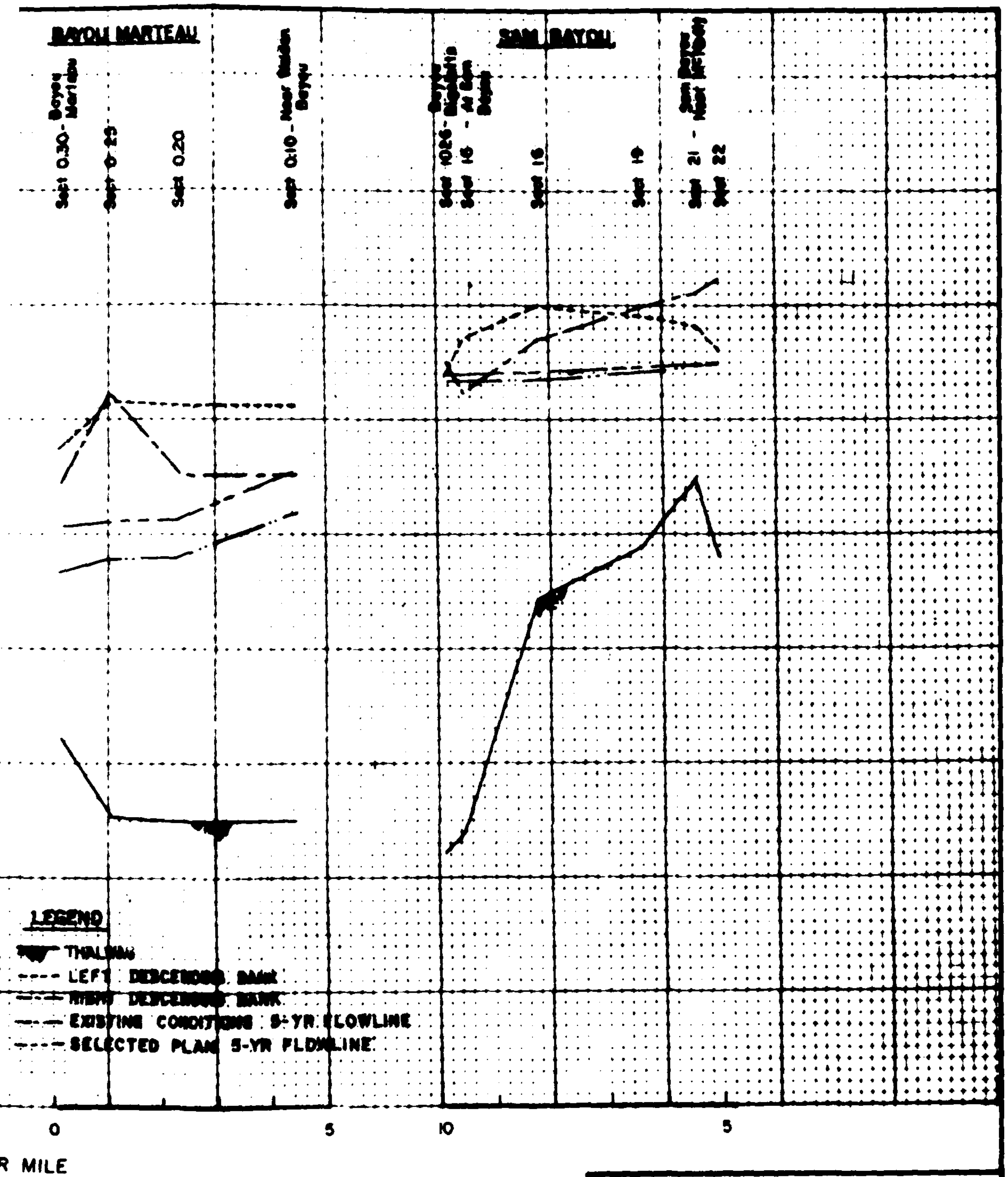
WATER SURFACE
5-YR FLOWLINE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-38

(3)


BAYOU DARROW
BAYOU MARTEAU
ELEVATION (FT. N.G.V.D)
RIVER MILE
Sect 1012
Sect 0.04 - Diversion Channel
Sect 0.30 - Bayou Marteau
Sect 0.03
Sect 0.02 - Diversion Channel
Sect 5
Sect 6
Sect 7
Sect 9
Sect 10
Sect 11
Sect 13
Sect 14
Sam Bayou
Sect 0.30 - Bayou Marteau
Sect 0.20
100
90
80
70
60
55
0
5
10
12
0
LEGEND
THALWEG
LEFT DESCENDING BANK
RIGHT DESCENDING BANK
EXISTING CONDITIONS
SELECTED PLAN 5-YR



ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

WATER SURFACE
5-YR FLOWLINE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

PLATE C-39

(2)

APPENDIX D

ECONOMIC ANALYSIS

ALOHA-RIGOLETTE AREA, LOUISIANA

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ALOHA-RIGOLETTE AREA STUDY

Appendix D

ECONOMIC ANALYSIS

D.0.1. This analysis provides an estimate of those project economic outputs that are creditable to the National Economic Development account (NED) under current Water Resources Council guidelines. The general methodology employed is described in Section 1. Section 2 provides a description of the area's economic climate and flood-related problems. Sections 3 and 4 relate in detail the benefit analyses for the six intermediate plans and Section 5 presents a summary of the annual costs and benefits. Section 6 presents the analyses of the plans designated for detailed study in order to achieve the maximization of net benefits.

SECTION 1. GENERAL

INTRODUCTION

D.1.1. This appendix was prepared in accordance with Engineering Regulation (ER) 1105-2-40, Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, and presents an economic evaluation of water resource improvements considered in the Aloha-Rigolette project area. During reconnaissance level studies, 13 alternative plans were recommended for intermediate study. Of these, only seven survived the initial intermediate screening: Plans 3, 5, 6, 9, 19, 20 and "no action." An additional alternative, the "no-structure" plan, was then added to those seven. In the intermediate screening, cost and benefits data were developed, analyzed, and screened. Three plans, 5, 6, and 19, survived to the detailed planning stage. In this stage, net benefits were optimized by analyzing a number of options, some with higher degrees of protection and some with lower.

D.1.2. The evaluation consists of a description of the methodology used to determine economic damages and benefits under existing and future conditions, project costs, and benefit-to-cost analyses. Present land use and hydrologic conditions as well as January 1985 price levels were used in the evaluation. The proposed improvements (see Appendix A, Plan Formulation) were evaluated by comparing estimated average annual benefits that would accrue to the project area over the project life with estimated average annual project costs. Benefits were converted to average annual values by use of the current Federal discount rate of 8-3/8 percent and a project economic life of 50 years. Historical flood records were converted to average annual bases using the frequency method of analysis. The estimated project base year (the year in which significant benefits will accrue to project construction) varies for each alternative.

SECTION 2. ECONOMIC DEVELOPMENT

GENERAL

D.2.1. The study area lies entirely within the alluvial valley of the Red River. For most of its length, Bayou Rigolette occupies a channel that was an ancient course of the Red River. The alluvial flatlands are composed of point bar sands, natural levee silts and silty sands, and dense backswamp clays. This area has been highly developed for agricultural activities in conjunction with a substantial shift in crop distribution from pasture, cotton, hay, and corn to soybeans. Approximately 41,389 acres are now in cropland or pasture, some 18,454 acres are wooded, and 857 acres occupy water areas. The U.S. Department of Agriculture, Soil Conservation Service, classifies virtually all of the farmland as prime farmland 1/.

D.2.2. The cities of Alexandria and Pineville are the primary marketing, commercial, and transportation centers of the area. Colfax, the parish seat of Grant Parish, is the only significant trade center located within the basin. The major highway traversing the basin is U.S. Highway 71, extending from Pineville north through the town of Aloha. Louisiana Highways 8 and 122 cross the basin in an east-west direction and numerous other small parish and farm-to-market roads are prevalent. Along the eastern periphery of the basin, U.S. Highway 167 extends from Pineville to the upper limits of the basin. The Kansas City Southern (KCS) Railway provides rail service within the basin and extends from Alexandria, through Colfax, and northward past Aloha. A second rail service along the eastern periphery of the basin is provided by the Chicago Rock Island and Pacific Railway and the KCS Railway. Major airfields are located in Shreveport, Louisiana, and in Alexandria.

1/ Prime farmlands are those which derive their value from their general advantage as cropland due to soil and water conditions.

D.2.3. Total employment in Grant, Rapides, and Winn Parishes in 1978 was some 65,000, most of which was in the Alexandria metropolitan area. Major employment sources were retail and wholesale trade, manufacturing, and the service sectors. Although the mean family income in 1980 was $16,701, some 19 percent of the population had incomes below the national poverty level. Table D-2-1 displays selected employment and income statistics for the three parishes in the study area. Table D-2-2 delineates the major employment sectors in Grant, Rapides, and Winn Parishes.

POPULATION

D.2.4. The resident population of the Aloha-Rigolette study area is primarily rural, scattered over a large area in low density patterns. The city of Colfax in Grant Parish is the only urban-type development in the basin with a 1980 population of 1,680. The total basin population in 1980 was 8,561. Over the past 50 years (1930-1980), the population has increased at an annual rate of 0.4 percent. This slow growth rate was primarily due to high outmigration rates between 1940 and 1960. Since 1960, the annual growth rate has been 1.0 percent. The rate of growth is expected to decline over the next 50 years, partially due to the trend to fewer but larger farms with associated decreases in agricultural employment. The growth rate between 1980 and 2040 is expected to average 0.58 percent annually. Table D-2-3 delineates population and growth rate statistics for the study area from 1930-2040.

FLOOD PROBLEMS AND NEEDS

D.2.5. Flooding in the project area occurs most frequently in the spring, but also occasionally occurs in the fall. The 3-year frequency flood will inundate an estimated 6,500 acres of cleared land in the project area while the 100-year frequency event will overflow an estimated 25,200 cleared acres. Flood damages occur to agricultural crops, agricultural noncrop items,

TABLE D-2-1

SELECTED EMPLOYMENT AND INCOME STATISTICS, 1980

Aloha-Rigolette Area

Parish	Population	Number Employed	Number Unemployed	Unemployment Rate	% Below Poverty Level	Mean Family Income	Median Family Income
				(%)	(%)	($)	($)
Grant	16,703	5,316	522	8.9	21.8	14,589	11,295
Rapides	135,282	48,015	3,499	6.8	17.9	17,313	13,398
Winn	17,253	5,057	744	12.8	25.3	13,116	10,100
Total or Weighted Average	169,238	58,388	4,765	7.5	19.0	16,616	12,854

SOURCE: U. S. Department of Labor, Employment and Training Administration, 1980 Census computer run 13 Jul 83, Lawrence Berkeley Laboratory.

TABLE D-2-2

MAJOR EMPLOYMENT SECTORS, 1980

Aloha-Rigolette Area

Parish	Service	Manufacturing	Construction	Agriculture	Retail	Other
	(%)	(%)	(%)	(%)	(%)	(%)
Grant	30	18	12	10	11	19
Rapides	35	9	9	6	18	23
Winn	25	30	9	6	15	15
Weighted Average	34	12	9	6	17	22

SOURCE: U. S. Department of Labor, Employment and Training Administration, 1980 Census computer run 13 Jul 83, Lawrence Berkeley Laboratory.

TABLE D-2-3

POPULATION STATISTICS AND ANNUAL GROWTH RATES

Aloha-Rigolette Area

Year	Parish: Grant	Parish: Rapides	Parish: Winn	Total	Annual Growth Rate
					(%)
1930[1]	5,969	356	677	7,002	
					0.83
1940[1]	6,456	478	668	7,602	
					-0.51
1950[1]	5,975	714	535	7,224	
					-0.30
1960[1]	5,480	1,045	485	7,010	
					0.41
1970[1]	5,373	1,412	516	7,301	
					1.60
1980[1]	5,966	2,066	529	8,561	
					0.80
1990[2]	6,470[3]	2,300[4]	500[5]	9,270	
					0.66
2000[2]	6,910[3]	2,500[4]	490[5]	9,900	
					0.50
2010[2]	7,290[3]	2,640[4]	480[5]	10,410	
					0.52
2020[2]	7,680[3]	2,800[4]	480[5]	10,960	
					0.51
2030[2]	8,100[3]	2,960[4]	470[5]	11,530	
					0.51
2040[2]	8,530[3]	3,130[4]	470[5]	12,130	

1/ Source: Bureau of the Census.

2/ Source: NOD estimates based on 1980 OBERS BEA Regional Projections.

3/ Based on Alexandria SMSA population projections for moderate change-in-share.

4/ Based on Alexandria SMSA population projections for no change-in-share.

5/ Based on Alexandria SMSA agricultural employment annual growth rate projections for no change-in-share.

public roads, and bridges. Only a few residential structures have been inundated in the recorded floods (see Appendix E, December 1982 Post Flood Investigation).

D.2.6. The preeminent importance of agricultural production to the area's economy is expected to continue. Principal crops include soybeans, pasture, grain sorghum, cotton, and soybeans/wheat double-cropped. Inadequate evacuation of frequent overflows has discouraged more intensified agricultural production practices. Substantial crop losses and the under-utilization of fertile and potentially productive agricultural areas have, in the opinion of agricultural interests, resulted from frequent overflows.

D.2.7. There is a clear need to reduce or alleviate flooding problems in the area. Either partial or complete flood protection would reduce the financial losses and risks involved in rural development by allowing more efficient use of agricultural lands and by reducing or eliminating flood damages. As a result of the threat of flood losses, farm owners and operators are reluctant to apply improved management techniques.

SECTION 3. FLOOD DAMAGE EVALUATION

HYDROLOGIC REACHES

D.3.1. For study purposes, the problem area was subdivided into two reaches that were considered as separate hydrologic units. These reaches, the Du Grappe Reach and the Rigolette Reach, are shown on Plate D-1.

FIELD SURVEYS

D.3.2. Under contract number DACW-29-82-D-0388 with Gulf South Research Institute/Gulf South Research Development Corporation (GSRI/GSRDC), field survey teams conducted interviews with farmers in the alluvial plain. The number of interviews was based on obtaining at least 30 percent coverage of the cleared acreage. In the Rigolette Reach, 27 farmers were interviewed, representing some 75 percent of the total land area. In the Du Grappe Reach, 11 farmers were interviewed, representing 39 percent of the total area. Each farmer was questioned regarding acres planted in each crop, frequency of floods, drainage problems encountered, and expected yields and cropping patterns if flooding were reduced and drainage improved. Figures D-1 and D-2 provide a summary of the responses given. Included are a description of the existing and most probable future agricultural land use of the Rigolette and Du Grappe reaches, respectively, and current agriculture-related problems and practices.

D.3.3. In addition to interviews with farmers, the Soil Conservation Service, U.S. Department of Agriculture, and the Louisiana State University Agricultural Experiment Station and Cooperative Extension Service were consulted for general information on soil characteristics and flood and drainage problems in the alluvial plain. The U.S. Census of Agriculture for Louisiana and the Crop Reporting Service were sources for other pertinent agricultural data.

DRAINAGE QUESTIONNAIRE

SUMMARY

Number of Respondents 27 Farm Location Grant and Rapides Parishes Reach No. Bayou Rigolette

Average No. of Years on Farm 21 (Range: 3 to 50) Average Size of Farm 1,300 acres (Range: 100 to 7,700 ac)

Watershed ______ Interviewer Guissinger/Ator/Ingram Date Fall 1982

Problem Area Land Use

Future Production Without Drainage			Future Production With Drainage			Remarks
Crop	Acres	Yield/Acre[a]	Crop	Acres	Yield/Acre[a]	
Soybeans	17,751	36 bu	Soybeans	18,391	43 bu	
Wheat[b]	4,115	40 bu	Wheat[b]	7,015	47 bu	
Pasture/ Hay[c]	6,140	6.3 tons	Pasture/ Hay[c]	5,790	6.3 tons	
Milo	2,629	38 cwt	Milo	2,504	43 cwt	
Cotton:	200		Cotton	200		
Lint		685 lbs	Lint		685 lbs	
Seed		.57 tons	Seed		.57 tons	
Corn	34	59 bu	Corn	159	67 bu	
Oats	200	--[d]	Oats	200	--[d]	
Sweet Potatoes	2	100 bu	Sweet Potatoes	2	100 bu	
Rice	0	--	Rice	250	38 cwt[e]	

1. What are your drainage problems? Water from Bayou Rigolette, Bayou Darrow & all smaller bayous that flow into them backs up on land; flooding is much worse when Red R. is high and locks are closed.
2. How often are you unable to plant a crop due to lack of adequate drainage? No, but often forced to plant late (15)[f]; 1 yr in 6 (1); 1 yr in 3 (1); never (3); rarely (4).
3. How often do you need to make a separate planting due to lack of adequate drainage? Never (6); 1 yr in 3 (4); 1 yr in 3-4 (1); 1 yr in 2-3 (1); occasionally (1); 1 yr in 4 (1); 1 yr in 6 (1); 1 yr in 2 (2); part every year (1); 1-2 times in 5 yrs (1).
4. How often are you unable to harvest a crop due to lack of adequate drainage? Never (11); 1 in 5 yrs it isn't practical to harvest (1); no, just delayed (3); 2 yrs in 10 (1); 1 yr in 5 (1); seldom (1).
5. How much lime do you spread on problem area? None (8); none, but could use some (1); 2 tons/ac every other year (1); 1 ton/ac every 5-8 yrs (1); yes, amount depends on soil samples (2); 1½ tons/ac every 5 yrs (1).
6. Would you use a different type and rate of fertilizer with adequate drainage? Yes ☐ (7) No ☒ (7)
7. If yes, what changes would you make? With better drainage would change crops & change type of fertilizer (1); fertilize area that floods that he doesn't fertilize now (1); would use less (1); would use more (4).

Remarks:
[a] Weighted average
[b] Double-cropped
[c] Hay acreage varies from year to year
[d] First year planted
[e] Parish average
[f] Number in parentheses represents number of farmers

FIGURE D-1

LAND USE IN TOTAL FLOODPLAIN

SUMMARY

Crop	No. of Acres	Usual Date for Production Practices: Land Preparation	Planting	Cultivating	Harvest	Date too late to Plant
Soybeans	17,751	May 21 (No d-c) May 30 (d-c)	May 5 (No d-c) Jun 5 (d-c)	(2-4T) May-Jul	Oct 14[a]	Jun 22
Wheat	4,115	Oct 8	Nov 7	None	May 20	Dec 13
Pasture/ Hay	6,140	Fertilize 1-4T per yr.	--	--	Cut hay 2-3T	--
Milo	2,629	Feb 23	Mar 27	(1-2T) Apr-May	Aug 10	May 30
Cotton	200	Apr 8	May 1	(3-4T) May-Jul	Oct 1	May 15
Corn	34	Feb 22	Mar 20	0-2T	Sep 5	May 1
Oats	200	Oct 22	Nov 1	None	--[b]	Nov 15
Sweet Potatoes	2	Feb-Mar	Apr 1-Jun 1	(2-3T) Apr-Jul	Jun 1-Fall	Jul 15

1 What changes in land use have you made due to floods? None (9)[c]; now plant beans inst of pasture (3); chgd fr cotton to beans (1); have chgd varieties of crops (1); land leveling/ditches (6); quit planting cotton on land that floods (1).

2 What changes would you make if the frequency of flooding were reduced by half? None (8); double crop more (4); 200-300 ac rice (1); maybe back to cotton or more milo (1); work land more (chemicals, etc.) (1); more pasture (1); more beans (1).

3 How often do large floods occur? (If the flood described above is a large flood, change this question to small floods.) Every yr (4); every other yr (2); 1 yr in 3 (3); 1 yr in 5 (2); occasionally (4); 1 yr in 10 (2); 1 yr in 12 (1).

4 During what seasons are floods most common? Spring (13); spring & fall (2); spring, fall, & winter (2).

5 In addition to the loss in yield described above, was there any damage to quality of crops? None (5); a little (6); yes, estimate 3% damage (1); estimate 50% damage (1); estimate 30% damage (1).

6 What damage did this flood do to roads and bridges nearby? None (12); roads wash out--hard to quantify amount (9).

T - Times over.
No d-c - No double-cropping.
d-c - Double cropping

[a] Average, depends on variety.

[b] Don't know; this is the first year to grow oats.

[c] Number in parentheses represents the number of farmers.

FIGURE D-1 (Continued)

DRAINAGE QUESTIONNAIRE

SUMMARY

Number of Respondents 11 Farm Location Grant Parish Reach No. Bayou Lu Grappe

Average No. of Years on Farm 19 (Range: 5 to 34) Average Size of Farm 491 acres (Range: 120 to 1,050 acre

Watershed ______ Interviewer Guissinger/Ator/Ingram Date Fall 198_

Problem Area Land Use

Future Production Without Drainage			Future Production With Drainage			Remarks
Crop	Acres	Yield/Acre[a]	Crop	Acres	Yield/Acre[a]	
Soybeans	2,640	34 bu	Soybeans	3,092	38 bu	
Wheat	1,100	39 bu	Wheat	2,040	43 bu	Could go from 1 cow/ 4 acres to 1 cow/2 acr with better drainage (
Pasture/ Hay	1,714	2.7 tons	Pasture/ Hay	1,412	3.6 tons/ acre	
Milo	300	3,375 lbs	Milo	350	3,964 lbs	

1. What are your drainage problems? Backwater flooding; bayous fill up because water has no place to go.
2. How often are you unable to plant a crop due to lack of adequate drainage? Delayed often (4)[b]; unable once (1); 1 year in 25 (1); sometimes can't plant part (1); 1 year in 3 (1).
3. How often do you need to make a separate planting due to lack of adequate drainage? 1 year in 3 (5); occasionally (1); not yet (1).
4. How often are you unable to harvest a crop due to lack of adequate drainage? Never (3); 2 years in 10 (1); 1 year in 5 (2); 1 year in 6 (1).
5. How much lime do you spread on problem area? None (5); rarely--depends on soil tests (1); 1 ton/acre every 5 years (1)
6. Would you use a different type and rate of fertilizer with adequate drainage? Yes ☒ (5) No ☒ (2)
7. If yes, what changes would you make? More fertilizer (5)

Remarks [a]Weighted average.
[b]Number in parentheses represents the number of farmers.

FIGURE D-2

LAND USE IN TOTAL FLOODPLAIN
SUMMARY

Crop	No. of Acres	Usual Date for Production Practices				Date too late to Plant
		Land Preparation	Planting	Cultivating	Harvest	
Soybeans	2,640	Mar-Apr	May 6	(3T) Jun-Jul	Oct	Jul 1
Wheat[a]	1,100	Oct-Nov	Oct-Nov	None	May 30	Dec 15
Pasture/Hay	1,714	--	Sep-Oct	--	(3T) Jun-Sep	--
Milo	300	Feb 28	Apr 2	(1T) May	Aug 20	May 8

1 What changes in land use have you made due to floods? Changed to beans fr pasture (1)[b]; changed fr pasture to beans (1); none (5); plant milo/ditches/land leveling (1); chgd fr pasture to cotton (1); chgd 50 ac fr row crops to pasture.

2 What changes would you make if the frequency of flooding were reduced by half? None (3); beans inst of pasture (2); incr pasture ac (1); maybe corn in area that now floods (1); plant wheat-DCW,beans (1); 50 ac back to row crops fr pasture (1); 50 ac milo (1); 200 ac beans, wheat(1).

3 How often do large floods occur? (If the flood described above is a large flood, change this question to small floods.) 1 yr in 3 (3); every yr (3); 1 yr in 10 (1); 1 yr in 5 (2); 1 yr in 5-6 (1); 6-7 of 20 yrs (1).

4. During what seasons are floods most common? Spring (4); spring/sometimes fall (4); Nov-Apr (1); anytime (1); fall,winter & early spring (1).

5 In addition to the loss in yield described above, was there any damage to quality of crops? Value reduced by 1/3 (1); at least every other yr 2 bu/ac (1); pasture hurt when water stands on it (2).

6. What damage did this flood do to roads and bridges nearby? None (3); some (4)--culverts & bridges float off; not an appreciable amount ( ).

T - Times over.

[a]Double-cropped--behind beans

[b]Number in parentheses represents the number of farmers.

FIGURE D-2 (Continued)

LAND USE AND CROP DISTRIBUTIONS AND YIELDS

D.3.4. The field survey represented a 66-percent sample of the total land subject to flooding. Present crop yields under flood-free conditions and land use estimates were obtained from the personal interviews with farm owners, farm operators, and county agricultural authorities. The land resource base and characteristics of farms involved were taken into consideration.

D.3.5. Existing land use was obtained from the farmers interviewed, from aerial photographs taken in November 1982, and from field observations and was delineated on USGS quadrangle maps. The information was then digitized and the resulting existing land use analysis shown in Table D-3-1.

TABLE D-3-1

EXISTING LAND USE - 1982

Aloha-Rigolette Area

Reach	Cleared	Wooded	Surface Water	Total
		(Acres)		
Du Grappe	9,219	4,330	151	13,700
Rigolette	32,170	14,124	706	47,000
Total	41,389	18,454	857	60,700
Percent	69%	30%	1%	100%

D.3.6. Present crop distributions for the without-project flood plain (existing and future conditions) and for the with-project flood plain (future condition) are shown in Table D-3-2. The percentage distribution figures are based on total cleared acres. It should be noted that no change in cropping pattern in the future is anticipated without project implementation.

D.3.7. Average crop yields under with- and without-project conditions for the crops produced in the study area are shown in Table D-3-3. Without-project yields under flood-free conditions were obtained from personal interviews with farmers. Future yields under with-project conditions were estimated by the farmers surveyed and reflect the average yields expected with implementation of a flood control project. Both with- and without-project yields for all crops were reviewed by county agents and local SCS representatives for reasonableness. In each case, the agricultural authorities agreed that the yield data were representative of the potential of the soils in the Aloha-Rigolette alluvial plain.

AGRICULTURAL CROP DAMAGE

D.3.8. In order to determine the average annual crop damages for with- and without-project conditions, the damage per cleared acre flooded was multiplied by the average annual cleared acres flooded. The methodology and the data used in crop damage calculations are discussed in subsequent paragraphs.

AVERAGE DAMAGE PER CLEARED ACRE FLOODED

D.3.9. The computer program entitled "Computerized Agricultural Crop Flood Damage Assessment System" (CACFDAS) was used in calculating average agricultural crop damage per cleared acre. CACFDAS was specifically developed for this purpose by the Department of Agricultural Economics at Mississippi State University for the Vicksburg District, Corps of Engineers.

TABLE D-3-2

EXISTING AND FUTURE CROP DISTRIBUTIONS

Aloha-Rigolette Area

Crop	Du Grappe Reach		Rigolette Reach		Project Area	
	(Acres)	(%)	(Acres)	(%)	(Acres)	(%)
Existing and Future Without-Project Conditions						
Soybeans	1,650	31	10,879	50	12,529	46
Pasture	2,183	41	4,787	22	6,970	27
Grain Sorghum	320	6	2,176	10	2,496	9
Cotton	-	0	217	1	217	<1
Oats	-	0	218	1	218	<1
Soybeans/Wheat Double Crop	1,171	22	3,481	16	4,652	17
Total	5,324		21,758		27,082	
Future With-Project Conditions						
Soybeans	1,118	21	9,138	42	10,256	39
Pasture	1,650	31	4,134	19	5,784	21
Grain Sorghum	373	7	1,958	9	2,331	9
Cotton	-	0	217	1	217	<1
Oats	-	0	218	1	218	<1
Soybeans/Wheat Double Crop	2,183	41	5,657	26	7,840	28
Corn	-	0	218	1	218	<1
Rice	-	0	218	1	218	<1
Total	5,324		21,758		27,082	

TABLE D-3-3

AVERAGE FLOOD-FREE YIELDS PER ACRE
WITHOUT- AND WITH-PROJECT CONDITIONS

Aloha-Rigolette Area

Crop	Du Grappe Reach		Rigolette Reach	
	Without-Project Yields	With-Project Yields	Without-Project Yields	With-Project Yields
Soybeans	34 bu	38 bu	36 bu	43 bu
Soybeans/Wheat Double Crop	32 bu	36 bu	35 bu	41 bu
Wheat/Soybeans Double Crop	39 bu	43 bu	40 bu	47 bu
Pasture	5.48 cwt	5.48 cwt	5.48 cwt	5.48 cwt
Milo	41.50 cwt	41.50 cwt	41.50 cwt	41.50 cwt
Cotton				
Lint	---	---	685 lbs	685 lbs
Seed	---	---	0.57 tons	0.57 tons

NOTE: bu=bushels; lbs=pounds; cwt=hundred weight

D.3.10. Crop budgets were developed by GSRI/GSRDC for each principal crop produced by farmers in the Aloha-Rigolette alluvial plain. Budgets were designed to reflect typical management practices and reflect input data on yields, production practices, and resource use rates commonly found in the study area. Research scientists and extension specialists affiliated with the Louisiana State University Agricultural Experiment Station provided supplemental technical data.

D.3.11. The CACFDAS program computes flood damages by crop, analyzing daily records of flood events. Damages from more than one flood event in the same year in the same area are also calculated by the program. In addition, the program permits specific crop replanting and/or crop substitution.

D.3.12. In calculating agricultural crop flood damages, the time of the flood event relative to the agricultural operations that have taken place in the production process is of critical importance. CACFDAS is structured to integrate historical hydrologic data and up-to-date crop budget information to provide an accurate estimate of flood damages to agricultural crops.

D.3.13. The number of days of inundation necessary to produce agricultural damages is expressed as a duration factor. Duration factors are developed for the four stages of plant development from planting through harvest. Depending on the particular crop and its stage of plant development, the duration factors range from 1 to 10 days. In addition, dates of normal planting, late planting, and the last date of planting by crop are also developed based on information obtained from farmers in the study area. In conjunction with the duration factors, these dates are critically important as they are the base dates from which flood damage, crop replanting, crop substitution, and crop yield reduction data are derived.

D.3.14. Production costs and fixed harvest costs, expected net returns above specified costs, and operation revenues consisting of realized gross value of the harvested crop are three cost variables used in the crop budget analysis. Operation revenues were calculated using October 1983 "Current Normalized Prices for Principal Commodities" and average crop yields. Other major computer requirements included crop distribution data, net and gross returns by crop, crop substitution data, and the number of cleared acres flooded on a daily basis.

D.3.15. CACFDAS runs were made for both with- and without-project conditions. 1/ Additional stratification of the flood plain was not deemed necessary as there is no substantial change in the cropping patterns above and below the 3-year flowline. Average damages per cleared acre flooded are shown in Table D-3-4. In addition, CACFDAS runs were made for with-project conditions assuming intensified land use.

CLEARED ACREAGE FLOODED

D.3.16. Cleared acreage flooded was derived from area probability curves developed through the integration of annual duration series stage-frequency relationships (see Appendix C, Engineering Investigations) and stage-area relationships. Presently cleared acreage flooded is presented in Table D-3-5 for both the Du Grappe Reach and the Rigolette Reach. Magnitudes of flooding shown include the 3-year, 10-year, and 100-year frequency overflows and the average annual overflows for with- and without-project conditions.

AVERAGE ANNUAL DAMAGES

D.3.17. Average annual crop damages for presently cleared acreages under without- and with-project conditions are presented in Table D-3-4. Total average annual agricultural flood damages are an estimated $48,575 in the

1/ Unless otherwise stated, all plans discussed refer to the middle optional size designated as the "B" option.

TABLE D-3-4

AVERAGE ANNUAL CROP DAMAGES

Aloha-Rigolette Area

	Du Grappe Reach			Rigolette Reach		
	Cleared Acres 1/	Damage/Flood Peak Acre 2/	Average Annual Crop Damages	Cleared Acres 1/	Damage/Flood Peak Acre 2/	Average Annual Crop Damages
Without Project	1,822	$26.66	$48,575	4,753	$30.82	$146,487
With Project 3/						
5/19	1,582	26.66	42,176	2,253	30.82	69,437
6	420	26.66	11,197	806	30.82	24,841
9_1	1,822	26.66	48,575	2,560	30.82	78,899
9_2	1,822	26.66	48,575	2,109	30.82	64,999
9_3	789	26.66	21,035	2,109	30.82	64,999
9_4	1,130	26.66	30,126	2,650	30.82	81,673
20	1,283	26.66	34,205	2,980	30.82	91,844

1/ From Table D-3-5

2/ Without intensified land use for project plans. Data from CACFDAS program.

3/ The second option of each plan was analyzed in detail.

SOURCE: Gulf South Research Development Corporation

TABLE D-3-5

CLEARED ACREAGE FLOODED

Aloha-Rigolette Area

	Without Project				With Project				
	3-Year Overflow	10-Year Overflow	100-Year Overflow	Average Annual Overflow	3-Year Overflow	10-Year Overflow	100-Year Overflow	Average Annual Overflow	Average Annual Acres Protected
	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)
Du Grappe Reach									
5/19	2,367	2,839	4,265	1,822	2,270	2,800	4,265	1,582	[illegible]
6	2,367	2,839	4,265	1,822	0	1,700	2,770	420	1,402
9_1	2,367	2,839	4,265	1,822	2,367	2,839	4,265	1,822	[illegible]
9_2	2,367	2,839	4,265	1,822	2,367	2,839	4,265	1,822	
9_3	2,367	2,839	4,265	1,822	1,135	2,400	3,360	789	[illegible]
9_4	2,367	2,839	4,265	1,822	1,750	2,400	3,600	1,136	692
20	2,367	2,839	4,265	1,822	1,950	2,770	4,130	1,283	539
Rigolette Reach									
5/19	4,129	12,621	20,921	4,753	350	5,500	20,125	2,253	2,500
6	4,129	12,621	20,921	4,753	0	1,000	13,950	806	3,947
9_1	4,129	12,621	20,921	4,753	250	5,125	19,625	2,560	2,193
9_2	4,129	12,621	20,921	4,753	206	4,223	16,171	2,109	2,644
9_3	4,129	12,621	20,921	4,753	206	4,223	16,171	2,109	2,644
9_4	4,129	12,621	20,921	4,753	360	5,125	19,875	2,650	2,103
20	4,129	12,621	20,921	4,753	1,100	10,000	20,150	2,980	1,773

Du Grappe Reach under existing conditions and $146,487 in the Rigolette Reach. Without project implementation, hydrologic conditions are estimated to remain essentially stable over the 50-year study period. With project implementation, crop distributions will change primarily in the direction of increased soybean/wheat double-cropping.

SECTION 4. EVALUATION OF BENEFITS

BENEFIT CATEGORIES

D.4.1. Agricultural benefits are divided into two mutually exclusive categories depending on whether there is a change in cropping patterns: damage reduction benefits and intensification benefits.

D.4.2. Damage reduction benefits accrue on lands where there is no change in cropping patterns between the with- and without-project conditions. These benefits represent the reduction in average annual crop and noncrop flood damages and increases in net income due to a plan as measured by farm budget analyses. The income increases may result from increased crop yields and decreased production costs.

D.4.3. Intensification benefits accrue on lands where there is a change in cropping patterns as a result of project installation. These benefits are from increased acreages of basic crops and are measured as the net value of the increased production.

DAMAGE REDUCTION BENEFITS - CROP

D.4.4. The damage reduction benefits that would accrue in the Aloha-Rigolette area from project implementation were computed in two phases. First, the reduction in existing flood damages as a result of project installation was measured. Second, the increases in net income due to increased crop yields and decreased production costs on lands with no change in cropping patterns were measured under with- and without-project conditions.

D.4.5. The benefits due to flood damage reduction on existing agricultural production are calculated as the difference between average annual flood damages under without-project conditions and the residual damages under with-project conditions. These benefits are shown by reach in Table D-4-1.

TABLE D-4-1

DAMAGE REDUCTION BENEFITS ON
EXISTING AGRICULTURAL PRODUCTION
(Jan 1985 Price Levels)

Aloha-Rigolette Area

Plan	Agricultural Damages: Without-Project	Agricultural Damages: With-Project	Damage Reduction Benefit
	($)	($)	($)
Du Grappe Reach			
5/19	48,575	42,176	6,399
6	48,575	11,197	37,378
9_1	48,575	48,575	0
9_2	48,575	48,575	0
9_3	48,575	21,035	27,540
9_4	48,575	30,126	18,449
20	48,575	34,205	14,370
Rigolette Reach			
5/19	146,487	69,437	77,050
6	146,487	24,841	121,646
9_1	146,487	78,899	67,588
9_2	146,487	64,999	81,488
9_3	146,487	64,999	81,488
9_4	146,487	81,673	64,814
20	146,487	91,844	54,643

D.4.6. The benefits due to increases in net income that are derived from increased crop yields and decreased production costs on lands with no change in cropping patterns are discussed in the following paragraphs.

D.4.7. When implementation of a project induces an activity to be more productive in its operations in the flood plain, the benefits that accrue as the result of that inducement are referred to as damage reduction benefits (ER 1105-2-40, change 2 dated July 9, 1983). The inherent financial risk associated with agricultural production activities is significantly reduced by implementation of flood protection measures. Furthermore, any reduction in financial risk will result in increased agricultural production activities that will produce higher crop yield levels and net returns.

D.4.8. The flooding conditions and soil types in the Aloha-Rigolette project area are ideally suited for the accrual of benefits due to increased production under with-project conditions. Floods of varying magnitudes occur on an annual basis. During personal interviews, farmers stated that recurrent flooding was adversely affecting management and planning activities. The soils in the Aloha-Rigolette alluvial plain fall into two major associations. The Moreland-Latanier association soils account for approximately 70 percent or roughly 42,000 acres. The remaining soils are not generally subject to increased yields because they are found on the natural levees of the Red River and area bayous and are mostly outside the 100-year flood plain.

D.4.9. The Moreland-Latanier association is made up of nearly level alkaline, clayey soils. These soils are in the alluvial plain of the Bayou Rigolette Basin adjacent to the natural levees on broad flats with slopes of less than one percent. The soils are somewhat poorly drained and have very slow permeability with water tables at one to three feet. Thus, when flood conditions occur, the poor permeability restricts plant growth for periods extending well after the flood waters recede. For this reason, the Soil Conservation Service (SCS) classifies the Moreland-Latanier association soils as IIIw and IVw, indicating that the soils are severely

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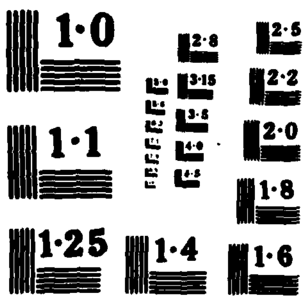
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limited for cultivation because of excess water. Soil scientists with the SCS reported that a major constraint to more efficient crop production in the Aloha-Rigolette problem area appears to be the lack of adequate drainage outlets in the basin. This is particularly evident in the spring just before, during, and after normal planting dates. For these reasons, the soils inside the 100-year frequency flood plain without project (not including the 3-year frequency flood plain with project) are likely to accrue damage reduction benefits as a result of increased net income.

D.4.10. Because of the high degree of risk and uncertainty that is associated with the perennial threat of flooding, farmers are unable to efficiently plan their farming operation. Under normal conditions, farmers develop their farm plans prior to the spring planting season in order to make commitments with suppliers to purchase seed, fertilizer, and chemicals, as well as tractors, trucks, other equipment, and supplemental farm labor. Since the acreage and types of crops planned for planting are generally known, financial requirements are prearranged through lending institutions.

D.4.11. With the present threat of flooding in the Aloha-Rigolette project area, farmers use of the "futures" market to stabilize the prices they will receive for their products is restricted. In addition, the threat of flooding inhibits the farmers' ability to decide what equipment or how many employees will be needed or what crop varieties, herbicides, or insecticides to purchase.

D.4.12. One of the most frequently cited constraints to efficient agricultural production in the area is not being able to plant on optimum planting dates because of wet soils. Under with-project conditions, farmers will be more able to select proper varieties and plant on optimum planting dates.

D.4.13. Planting recommended varieties at the appropriate times will result in increased yields from use of periods of more favorable plant growth and harvest conditions, fewer insect and weed pressures, increased machinery efficiency, and an increase in the number of days suitable for various production operations. In addition, the implementation of production practices that optimize yield levels and net returns (such as on-farm drainage, higher levels of fertilization, and soil improvements resulting from conservation cropping practices) is constrained by frequent flooding.

D.4.14. Benefits from higher yields are based on the increased net productive value per acre that results from intensified farming operations made possible by project-related flood reductions and drainage improvements. Increases in the net productive value per acre are based on the difference between yield levels and crop distributions under without- and with-project conditions, as shown in Tables D-4-2 and D-4-3. The increases in yield levels shown in these tables are based on information collected by the GSRI/GSRDC survey during personal interviews with farmers in the flood plain area, Soil Conservation Service personnel, and the county agricultural agents. Table D-4-4 shows the acreage subject to increased net returns while Tables D-4-5 and D-4-6 display the increase in the net productive value of the area under conditions of no change in cropping pattern and of changes in the cropping pattern, respectively. In order to derive the damage reduction benefits from increased yields, the remaining flood damages must be subtracted from the increase in the net productive value of the area. These computations are shown in Table D-4-7. Table D-4-8 displays the percentage of damage prevented by the proposed alternatives based on the reduction of average annual flood damages within the flood plain. It is reasonable to assume that this same degree of protection will exist with increased crop yields. Agricultural damage reduction benefits for the two categories previously explained are summarized in Table D-4-9.

Table D-4-2

INCREASE IN NET PRODUCTIVE VALUE
(No change in cropping pattern)

Du Grappe Reach

Part A-Existing Conditions (1983)

Land Use	Without Project: Price	Without Project: Percent Distribution 1/	Without Project: Yield Per Acre	Without Project: Gross Value	Without Project: Production Costs	Without Project: Net Return	Without Project: Weighted Net Value Without Project	With Project: Percent Distribution	With Project: Yield Per Acre	With Project: Gross Value	With Project: Production Costs	With Project: Net Returns	With Project: Weighted Net Value With Project	Increase In Net Productive Value Per Acre
Soybeans	$7.45/bu	31	34 bu	$253.30	$181.13	$72.17	$22.37	21	38 bu	$283.10	$181.13	$101.97	$21.41	-0.96
Beans/Wheat Double Crop	7.45/bu	22	32 bu	238.40	146.04	92.36	20.32	41	36 bu	268.20	146.04	122.16	50.09	29.77
Wheat/Beans Double Crop	3.88/bu	22	39 bu	151.32	99.36	51.96	11.43	41	43 bu	166.84	99.36	67.48	27.67	16.24
Pasture	68.61/cwt	41	5.48 cwt	375.98	375.98	0.00	0.00	31	5.48 cwt	375.98	375.98	0.00	0.00	0.00
Grain Sorghum	5.04/cwt	6	41.5 cwt	209.16	196.96	12.20	0.73	7	41.5 cwt	209.16	196.96	12.20	0.85	0.12
TOTAL							$54.85						$100.02	45.17

Part B Future Conditions (2041)

Land Use	Without Project: Price	Without Project: Percent Distribution 1/	Without Project: Yield Per Acre	Without Project: Gross Value	Without Project: Production Costs	Without Project: Net Return	Without Project: Weighted Net Value Without Project	With Project: Percent Distribution	With Project: Yield Per Acre	With Project: Gross Value	With Project: Production Costs	With Project: Net Returns	With Project: Weighted Net Value With Project	Increase In Net Productive Value Per Acre
Soybeans	$7.45/bu	31	47 bu	350.15	135.85	214.30	66.43	21	55 bu	409.75	135.85	273.90	57.52	-8.91
Beans/Wheat Double Crop	7.45/bu	22	44 bu	327.80	109.53	218.27	48.02	41	52 bu	387.40	109.53	277.87	113.93	65.91
Wheat/Beans Double Crop	3.88/bu	22	53 bu	205.64	74.52	131.12	28.85	41	59 bu	228.92	74.52	154.40	63.30	34.45
Pasture	68.61/cwt	41	10.01 cwt	686.79	281.99	404.80	165.97	31	10.01 cwt	686.79	281.99	404.80	125.49	-40.48
Grain Sorghum	5.04/cwt	6	56.9 cwt	286.78	147.72	139.06	8.34	7	56.9 cwt	286.78	147.72	139.06	9.73	1.39
TOTAL							$317.61						369.97	$52.36

SOURCE: Gulf South Research Development Corporation.

1/ Percent distribution is greater than 100% due to wheat/soybeans double cropping.

TABLE D-4-3

INCREASE IN NET PRODUCTIVE VALUE
(No change in cropping pattern)

Rigolette Reach

Part A-Existing Conditions (1983)

Land Use	Without Project: Price	Percent Distribution 1/	Yield Per Acre	Gross Value	Production Costs	Net Return	Weighted Net Value Without Project	With Project: Percent Distribution	Yield Per Acre	Gross Value	Production Costs	Net Returns	Weighted Net Value With Project	Increase In Net Productive Value Per Acre
Soybeans	$7.45/bu	50	36 bu	$268.20	$181.13	$87.07	$43.54	42	43 bu	$320.15	$181.13	$139.22	$58.45	$14.93
Beans/Wheat Double Crop	7.45/bu	16	35 bu	260.75	146.04	114.71	18.35	26	44 bu	305.45	146.04	159.41	41.45	23.10
Wheat/Beans Double Crop	3.88/bu	16	40 bu	155.20	99.36	55.84	8.93	26	47 bu	182.36	99.36	83.00	21.58	12.65
Pasture	68.61/cwt	23	5.48 cwt	375.98	375.98	0.00	0.00	22	5.48 cwt	375.98	375.98	0.00	0.00	0.00
Grain Sorghum	5.04/cwt	10	41.5 cwt	209.16	196.96	12.20	1.22	9	43 cwt	216.72	196.96	19.76	1.78	0.56
Cotton		1			$441.75	$68.94	0.69	1			$441.75	$68.94	$0.69	[illegible]
Lint	0.651		685 lbs	445.94					685 lbs	445.94				
Seed	$113.60/ton		0.57 tons	64.75					0.57 tons	64.75				
TOTAL							$72.73						$123.97	[illegible]

Part B- Future Conditions (2041)

Land Use	Without Project: Price	Percent Distribution 1/	Yield Per Acre	Gross Value	Production Costs	Net Return	Weighted Net Value Without Project	With Project: Percent Distribution	Yield Per Acre	Gross Value	Production Costs	Net Returns	Weighted Net Value With Project	Increase In Net Productive Value Per Acre
Soybeans	$7.45/bu	50	49 bu	365.05	135.85	229.20	114.60	42	59 bu	$439.55	$135.85	$303.70	$127.55	$12.95
Beans/Wheat Double Crop	7.45/bu	16	47 bu	350.15	109.53	240.62	38.50	26	56 bu	417.20	109.53	307.67	79.99	41.49
Wheat/Beans Double Crop	3.88/bu	16	55 bu	213.40	74.52	138.88	22.22	26	64 bu	248.32	74.52	173.80	45.19	22.97
Pasture	68.61/cwt	23	10.01 cwt	686.79	281.99	404.80	93.10	22	10.01 cwt	686.79	281.99	404.80	89.06	-4.04
Grain Sorghum	5.04/cwt	10	56.9 cwt	286.78	147.72	139.06	13.91	9	58.9 cwt	[illegible]	[illegible]	149.14	13.42	[illegible]
Cotton		1			$331.31	$367.94	3.68	1			$331.31	[illegible]	[illegible]	[illegible]
Lint	0.651/lb		938 lbs	610.64					938 lbs	$610.64				
Seed	$113.60/ton		0.78 tons	$88.61					0.78 tons	88.61				
TOTAL							$286.01						[illegible]	[illegible]

SOURCE: Gulf South Research Development Corporation.

TABLE D-4-4

ACREAGE SUBJECT TO INCREASED NET RETURNS

Aloha-Rigolette Area

Alternative	100 Year Frequency W/O Project	3-Year Frequency With Project	Subject to Increased Net Returns	Increased Yield Portion 1/	Distribution Change Portion 2/
	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)
Du Grappe Reach					
5/19	4,265	2,270	1,995	1,596	399
6	4,265	0	4,265	3,412	853
9_1	4,265	2,367	1,898	1,518	380
9_2	4,265	2,367	1,898	1,518	380
9_3	4,265	1,135	3,130	2,504	626
9_4	4,265	1,750	2,515	2,012	503
20	4,265	1,950	2,315	1,852	463
Rigolette Reach					
5/19	20,921	350	20,571	18,317	2,254
6	20,921	0	20,921	18,620	2,301
9_1	20,921	250	20,671	18,397	2,274
9_2	20,291	206	20,715	18,436	2,279
9_3	20,291	206	20,715	18,436	2,279
9_4	20,291	360	20,561	18,299	2,262
20	20,291	1,100	19,821	17,641	2,180

1/ Damage reduction benefits accrue on those acres where there is no change in cropping pattern between with- and without-project conditions: Du Grappe Reach-80%, Rigolette Reach-89%. Increased net returns accrue from higher yields.

2/ Intensification benefits accrue on those acres where there is a change in cropping patterns: Du Grappe Reach-20%, Rigolette Reach-11%. Increased net returns accrue from both higher yields and a change in the crop distribution.

TABLE D-4-5

INCREASE IN THE PRODUCTIVE VALUE OF THE AREA

(No Change in Cropping pattern)

Alternative	Subject to Increased Net Returns	Existing: Increase in the Productive Value	Existing: Total Increase	Future: Increase in the Productive Value	Future: Total Increase
	(ac.)	($/ac.)	($)	($/ac.)	($)
Du Grappe Reach 1/					
5/19	1,596	45.17 1/	72,091	52.36 1/	83,567
6	3,412	45.17 1/	154,120	52.36 1/	178,652
9_1	1,518	45.17 1/	68,568	52.36 1/	79,482
9_2	1,518	45.17 1/	68,568	52.36 1/	79,482
9_3	2,504	45.17 1/	113,106	52.36 1/	131,109
9_4	2,012	45.17 1/	90,882	52.36 1/	105,348
20	1,852	45.17 1/	83,655	52.36 1/	96,971
Rigolette Reach 2/					
5/19	18,317	51.24 2/	938,563	72.88 2/	1,334,943
6	18,620	51.24 2/	954,089	72.88 2/	1,357,026
9_1	18,397	51.24 2/	942,662	72.88 2/	1,340,773
9_2	18,436	51.24 2/	944,661	72.88 2/	1,343,616
9_4	18,346	51.24 2/	944,661	72.88 2/	1,343,616
9_5	18,299	51.24 2/	937,641	72.88 2/	1,333,631
20	17,641	51.24 2/	903,925	72.88 2/	1,285,676

1/ From Table D-4-2

2/ From Table D-4-3

TABLE D-4-6

INCREASE IN THE PRODUCTIVE VALUE OF THE AREA

(Changes in Cropping pattern)

Alternative	Acres to be Intensified	Existing: Increase in the Productive Value	Existing: Total Increase	Future: Increase in the Productive Value	Future: Total Increase
	(ac.)	($/ac.)	($)	($/ac.)	($)
Du Grappe Reach 1/					
5/19	399	125.92 1/	50,242	100.00 1/	39,900
6	853	125.92 1/	107,410	100.00 1/	85,300
9_1	380	125.92 1/	47,850	100.00 1/	38,000
9_2	380	125.92 1/	47,850	100.00 1/	38,000
9_3	626	125.92 1/	78,826	100.00 1/	62,600
9_4	503	125.92 1/	63,338	100.00 1/	50,300
20	463	125.92 1/	58,301	100.00 1/	46,300
Rigolette Reach 2/					
5/19	2,254	132.47 2/	298,587	162.73 2/	366,793
6	2,301	132.47 2/	304,813	162.73 2/	374,442
9_1	2,274	132.47 2/	301,237	162.73 2/	370,048
9_2	2,279	132.47 2/	301,899	162.73 2/	370,862
9_4	2,279	132.47 2/	301,899	162.73 2/	370,862
9_5	2,262	132.47 2/	299,647	162.73 2/	368,095
20	2,180	132.47 2/	288,785	163.73 2/	354,751

1/ From Table D-4-11

2/ From Table D-4-12

TABLE D-4-7

DAMAGE REDUCTION BENEFITS
INCREASED YIELDS

Aloha-Rigolette Area

A. Flood Damage Remaining:

(1) With-Project Conditions, With-Project Yield Levels

Plan	Damage per Flood Peak Acre 1/		Average Annual Acres Flooded 2/		Percent Subject to Increased Yields Only		Flood Damage
	($)		(ac.)		(%)		(%)
Du Grappe Reach							
5/19	41.23	x	1,582	x	.80	=	52,181
6	41.23	x	420	x	.80	=	13,853
9_1	41.23	x	1,822	x	.80	=	60,097
9_2	41.23	x	1,822	x	.80	=	60,097
9_3	41.23	x	789	x	.80	=	26,024
9_4	41.23	x	1,130	x	.80	=	37,272
20	41.23	x	1,283	x	.80	=	42,318
5/19	39.76	x	2,253	x	.89	=	79,726
6	39.76	x	806	x	.89	=	28,521
9_1	39.76	x	2,560	x	.89	=	90,589
9_2	39.76	x	2,109	x	.89	=	74,630
9_3	39.76	x	2,109	x	.89	=	74,630
9_4	39.76	x	2,650	x	.89	=	93,774
20	39.76	x	2,980	x	.89	=	185,451

(2) With-Project Conditions, Without-Project Yield Levels

5/19	26.66	x	1,582	x	.80	=	33,741
6	26.66	x	420	x	.80	=	8,958
9_1	26.66	x	1,822	x	.80	=	38,860
9_2	26.66	x	1,822	x	.80	=	38,860
9_3	26.66	x	789	x	.80	=	16,828
9_4	26.66	x	1,130	x	.80	=	24,101
20	26.66	x	1,283	x	.80	=	27,364
5/19	30.82	x	2,253	x	.89	=	61,799
6	30.82	x	806	x	.89	=	22,108
9_1	30.82	x	2,560	x	.89	=	70,220
9_2	30.82	x	2,109	x	.89	=	57,849
9_3	30.82	x	2,109	x	.89	=	57,849
9_4	30.82	x	2,650	x	.89	=	72,689
20	30.82	x	2,980	x	.89	=	81,741

(3) Increase in Damages

Plan	Damages With Increased Yields ($)		Damages Without Increased Yields ($)		Increases in Damages ($)
Du Grappe Reach					
5/19	52,181	-	33,741	=	18,440
6	13,853	-	8,958	=	4,895
9_1	60,097	-	38,860	=	21,237
9_2	60,097	-	38,860	=	21,237
9_3	26,024	-	16,828	=	9,196
9_4	37,272	-	24,101	=	13,171
20	42,310	-	27,364	=	14,954
Rigolette Reach					
5/19	79,726	-	61,799	=	17,927
6	28,521	-	22,108	=	6,413
9_1	90,589	-	70,220	=	20,369
9_2	74,630	-	57,849	=	16,781
9_3	74,630	-	57,849	=	16,781
9_4	93,774	-	72,689	=	21,085
20	185,451	-	81,741	=	103,710

B. Total Annual Benefits - Existing

Plan	Increase In Productive Value of Area 3/ ($)	Increase in Damages ($)		Percentage of Damages Prevented (%)		Average Annual Benefits ($)
Du Grappe Reach						
5/19	72,091	18,440	x	0.18	=	6,975
6	154,120	4,895	x	0.77	=	114,903
9_1	68,568	21,237	x	0.00	=	0
9_2	68,568	21,237	x	0.00	=	0
9_3	113,106	9,196	x	0.57	=	59,229
9_4	90,802	13,171	x	0.38	=	29,530
20	83,655	14,954	x	0.30	=	20,610
Rigolette Reach						
5/19	938,563	17,927	x	0.53	=	487,937
6	954,089	6,413	x	0.83	=	786,571
9_1	942,662	20,369	x	0.46	=	424,255
9_2	944,661	16,781	x	0.56	=	519,613
9_3	944,661	16,781	x	0.56	=	519,613
9_4	937,641	21,085	x	0.44	=	403,285
20	903,925	103,710	x	0.37	=	296,080

TABLE D-4-7 (continued)

C. Total Annual Benefits - Future

Plan	Increase In Productive Value of Area 3/ ($)	Increase in Damages ($)		Percentage of Damages Prevented 4/ (%)		Average Annual Benefits ($)
Du Grappe Reach						
5/19	83,567	18,440	x	0.13	=	8,467
6	178,652	4,895	x	0.77	=	133,793
9_1	79,482	21,237	x	0.00	=	0
9_2	79,482	21,237	x	0.00	=	0
9_3	131,109	9,196	x	0.57	=	69,490
9_4	105,348	13,171	x	0.38	=	35,027
20	96,971	14,954	x	0.30	=	24,605
Rigolette Reach						
5/19	1,334,943	17,927	x	0.53	=	698,018
6	1,357,098	6,413	x	0.83	=	1,121,069
9_1	1,340,773	20,369	x	0.46	=	607,386
9_2	1,343,616	16,781	x	0.56	=	743,028
9_3	1,343,616	16,781	x	0.56	=	743,028
9_4	1,333,631	21,085	x	0.44	=	577,520
20	1,285,676	103,710	x	0.37	=	437,327

D. Present Value

Plan	Existing Benefit ($)	Future Benefit ($)	Present Value (Average Annual Equivalent) ($)
Du Grappe Reach			
5/19	6,975	8,467	7,734
6	114,903	133,793	124,513
9_1	0	0	0
9_2	0	0	0
9_3	59,229	69,490	64,448
9_4	29,530	35,027	32,326
20	20,610	24,605	22,642
Rigolette Reach			
5/19	487,937	698,018	594,803
6	786,571	1,121,069	956,727
9_1	424,255	607,386	517,411
9_2	519,613	743,028	633,262
9_3	519,613	743,028	633,262
9_4	403,285	577,520	491,917
20	296,080	437,327	367,929

1/ From CACFDAS program
2/ Date from Table D-3-5
3/ Data from Table D-4-5
4/ Data from Table D-4-8

TABLE D-4-8

PERCENTAGE OF DAMAGE PREVENTED

Aloha-Rigolette Area

Reach/Plan	Damages Prevented	Damages Without-Project	Percentage of Damages Prevented
Du Grappe Reach			
5/19	6,399	48,575	13
6	37,378	48,575	77
9_1	0	48,575	0
9_2	0	48,575	0
9_3	27,540	48,575	57
9_4	18,449	48,575	38
20	14,370	48,575	30
Rigolette Reach			
5/19	77,050	146,487	53
6	121,646	146,487	83
9_1	67,558	146,487	46
9_2	81,488	146,487	56
9_3	81,488	146,487	56
9_4	64,814	146,487	44
20	54,643	146,487	37

TABLE D-4-9

AVERAGE ANNUAL DAMAGE REDUCTION BENEFITS - AGRICULTURE

Aloha-Rigolette Area

Damage Category/Reach	Alternative 5/19	6	9_1	9_2	9_3	9_4	20
Reduced Flood Damage 1/							
Du Grappe Reach	6,399	37,378	0	0	27,540	18,449	14,370
Rigolette Reach	77,050	121,646	67,588	81,488	81,488	64,814	54,643
TOTAL	83,449	159,024	67,588	81,488	109,028	83,263	69,013
Rounded	83,000	159,000	68,000	81,000	109,000	83,000	69,000
Increased Yields 2/							
Du Grappe Reach	7,344	124,513	0	0	64,448	32,326	22,642
Rigolette Reach	594,803	956,727	517,411	633,262	633,262	491,917	367,929
TOTAL	602,147	1,081,240	517,411	633,262	697,710	524,243	390,571
Rounded	602,000	1,081,000	517,000	633,000	698,000	524,000	391,000
TOTAL AVERAGE ANNUAL BENEFITS	685,000	1,240,000	585,000	714,000	807,000	607,000	460,000

1/ From Table D-4-1

2/ From Table D-4-7

D.4.15. Future food and fiber needs make continued productivity gains through knowledge and technology even more critical. According to one U.S. Department of Agriculture (USDA) estimate in the August 1980 issue of Farmline, agricultural productivity is expected to increase on an average of 1 1/2 to 2 percent per year due to advances in technology. United States agricultural history reflects four distinct periods based on major sources of technological change: hand power, horse power, mechanical power, and modern science. In each of the previous periods, as productivity reached or approached limits of growth from the dominant technology, a new technology emerged and stimulated productivity to a higher growth curve. USDA estimates indicate that yields will continue to increase through greater use of basic technologies such as hybrid seed, more fertilizer, improved equipment, planting and cultivation practices, and chemicals. In addition, scientists expect new families of technologies to emerge, some of which are already appearing. Many analysts feel some of these have great potential and could propel agricultural productivity into a new growth spiral when they become commercially available. One area now in development that is expected to play a big role in the future is photosynthesis enhancement. Other areas include bioregulators, water and fertilizer management, new pest control strategies, multiple and intensive cropping, reduced tillage, bioprocessing, and new crop development.

D.4.16. Science-based technology, unlike natural resources, is a man-made resource that can be continuously renewed through research and development. These advances will undoubtedly have dramatic impact upon productivity. However, adequate flood protection is critical to farmers within the study area if they are to be capable of utilizing the resources and technology available to them. Therefore, increases in yields due to future improvements in technology are included as discussed in paragraph 2.3.3(d), Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G).

D.4.17. Existing crop yields were projected to account for future increases due to improvements in technology based on the extrapolation of the historical trend in crop output per acre in the delta states region. The reference historical data were obtained from Table 25, Economic Indicators of the Farm Sector, Production and Efficiency Statistics, 1981, USDA, ERS. A first degree polynominal based on the historical trend of crop output per acre yielded the equation $Y = 13.01492 + .00714 (x)$ where x equals the year.

D.4.18. Future crop production costs (inputs) were projected based on the historical trend in crop production cost per acre. These per acre production costs were estimated by converting a "total" cropland acreage table (Table 64 of the publication referenced in paragraph D.4.17.) to a per acre basis using a total cropland index. A first degree polynominal based on this historical trend of input per acre yielded the equation $Y = 11.53207 - .00521(x)$ where x equals year.

DAMAGE REDUCTION BENEFITS - NONCROP

D.4.19. Noncrop benefits were based on historic flood damage information. Though the integration of stage-frequency and stage-damage relationships, damage-probability relationships were developed. Computation of the areas under the curves yielded average annual damages for without- and with-project conditions. The noncrop damage reduction benefits are shown in Table D-4-10.

INTENSIFICATION BENEFITS

D.4.20. Intensification benefits were computed in a manner similar to the increased yield portion of the damage reduction benefits. The primary difference between the increased yield portion of the damage reduction

TABLE D-4-10

AVERAGE ANNUAL DAMAGE REDUCTION BENEFITS - NONCROP
Aloha-Rigolette Area

Reach/Damage Category	Alternative 5/19	6	9_1	9_2	9_3	9_4	20
	($)	($)	($)	($)	($)	($)	($)
Du Grappe Reach							
--Without Project--							
Residential and Commercial	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Roads and Bridges	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Average Annual Damages	39,000	39,000	39,000	39,000	39,000	39,000	39,000
--With Project--							
Residential and Commercial	3,000	1,000	30,000	30,000	12,000	11,000	10,000
Roads and Bridges	1,000	1,000	9,000	9,000	3,000	2,000	2,000
Residual Average Annual Damages	4,000	2,000	39,000	39,000	15,000	13,000	12,000
Net Average Annual Benefits	35,000	37,000	0	0	24,000	26,000	27,000
Rigolette Reach							
--Without Project--							
Residential and Commercial	46,000	46,000	46,000	46,000	46,000	46,000	46,000
Roads and Bridges	24,000	24,000	24,000	24,000	24,000	24,000	24,000
Average Annual Damages	70,000	70,000	70,000	70,000	70,000	70,000	70,000
--With Project--							
Residential and Commercial	3,000	1,000	3,000	2,000	2,000	4,000	6,000
Roads and Bridges	2,000	1,000	3,000	2,000	2,000	3,000	7,000
Residual Average Annual Damages	5,000	2,000	6,000	4,000	4,000	7,000	13,000
Net Average Annual Benefits	65,000	68,000	64,000	66,000	66,000	63,000	57,000
TOTAL AVG ANNUAL BENEFITS	100,000	105,000	64,000	66,000	90,000	89,000	84,000

benefits and the intensification benefits is that intensification benefits consider the increased net income on lands that will have a cropping pattern with project different from the without project pattern. Tables D-4-11 and D-4-12 display the increases in net productive value per acre for lands subject to intensification, that is, changes in the cropping pattern. Table D-4-13 shows the computation of the annual intensification benefits for each of the project alternatives. As was stated for the damage reduction category, benefits for Alternatives 5 and 19 under high tailwater conditions have been deleted from the table as there are no flood damages prevented and zero benefits would accrue. Table D-4-14 delineates the intensifications benefits that will accrue to each project alternative.

D.4.21. The potential for induced clearing was estimated in the following manner. The area between the 3-year and 10-year overflows was planimetered without-project conditions and distributed according to cleared and wooded acreages. The without-project 3 to 10 zone percent-wooded factor was then applied to the zone between the 3-year with- and 3-year without-project overflow lines. This procedure yielded no projected project-induced woodlands clearing. In addition, Gulf South Research Institute recently interviewed area farmers, covering about 67 percent of the total land in the study area. There was no indication by the farmers interviewed of any remaining woodlands not being cleared due to flooding problems which would be cleared if flooding were substantially alleviated.

TOTAL FLOOD CONTROL BENEFITS

D.4.22. Total average annual flood control benefits from implementation of each project alternative are shown in Table D-4-15. Benefits will result from flood damage reduction to crop and noncrop items and from a general intensification of agricultural activities due to the reduced flood hazard and the improved drainage conditions.

Table D-4-11

INCREASE IN NET PRODUCTIVE VALUE
ON INTENSIFIED ACRES

Du Grappe Reach

Part A-Existing Conditions (1983)

	Without Project							With Project						
Land Use	Price	Percent Distribution 1/	Yield Per Acre	Gross Value	Production Costs	Net Return	Weighted Net Value Without Project	Percent Distribution	Yield Per Acre	Gross Value	Production Costs	Net Returns	Weighted Net Value With Project	Increase In Net Productive Value Per Acre
Soybeans	$7.45/bu	31	34 bu	$253.30	$181.13	$72.17	$22.37	0					$ 0.00	$-22.37
Beans/Wheat Double Crop	7.45/bu	22	32 bu	238.40	146.04	92.36	20.32	95	36 bu	$268.20	$146.04	122.16	116.05	95.73
Wheat/Beans Double Crop	3.88/bu	22	39 bu	151.32	99.36	51.96	11.43	95	43 bu	166.84	99.36	67.48	64.11	52.68
Pasture		41	5.48 cwt	375.98	375.98	0.00	0.00	0					0.00	0.00
Grain Sorghum	5.04/cwt	6	41.5 cwt	209.16	196.96	12.20	0.73	5	41.5 cwt	209.16	196.96	12.20	0.61	-0.12
TOTAL							$54.85						$180.77	$125.92

Part B- Future Conditions (2041)

	Without Project							With Project						
Land Use	Price	Percent Distribution 1/	Yield Per Acre	Gross Value	Production Costs	Net Return	Weighted Net Value Without Project	Percent Distribution	Yield Per Acre	Gross Value	Production Costs	Net Returns	Weighted Net Value With Project	Increase In Net Productive Value Per Acre
Soybeans	$7.45/bu	31	47 bu	$350.15	$135.85	$214.30	$66.43	0					$0.00	$-66.43
Beans/Wheat Double Crop	7.45/bu	22	44 bu	327.80	109.53	218.27	48.02	95	52 bu	387.40	109.53	277.87	263.98	215.96
Wheat/Beans Double Crop	3.88/bu	22	53 bu	205.64	74.52	131.12	28.85	95	59 bu	228.92	74.52	154.40	146.68	117.83
Pasture		41	10.01 cwt	686.79	281.99	404.80	165.97	0					0.00	-165.97
Grain Sorghum	5.04/cwt	6	56.9 cwt	286.78	147.72	139.06	8.34	5	56.9 cwt	286.78	147.72	139.06	6.95	-1.39
TOTAL							$317.61						$417.61	$100.00

SOURCE: Gulf South Research Development Corporation.

Table D-4-12

INCREASE IN NET PRODUCTIVE VALUE
ON INTENSIFIED ACRES

Rigolette Reach

Part A-Existing Conditions (1983)

	Without Project							With Project						
Land Use	Price	Percent Distribution 1/	Yield Per Acre	Gross Value	Production Costs	Net Return	Weighted Net Value Without Project	Percent Distribution	Yield Per Acre	Gross Value	Production Costs	Net Returns	Weighted Net Value With Project	Increase In Net Productive Value Per Acre
Soybeans	$7.45/bu	50	36 bu	$268.20		$87.07	$43.54	0					$ 0.00	$-43.54
Beans/Wheat Double Crop	7.45/bu	16	35 bu	260.75		114.71	18.35	84	41 bu	$305.45		$159.41	133.90	115.64
Wheat/Beans Double Crop	3.88/bu	16	40 bu	155.20		55.84	8.93	84	47 bu	182.36		83.00	69.72	60.79
Pasture	68.61/cwt	23	5.48 cwt	375.98	375.98	0.00	0.00	8	5.48 cwt	375.98	375.98	0.00	0.00	0.00
Grain Sorghum	5.04/cwt	10	41.5 cwt	209.16		12.20	1.22	8	43 cwt	216.72		19.76	1.58	0.36
Cotton		1			$441.75	68.94	0.69	0					0.00	-0.71
Lint Seed	0.65/1b 113.60/ton		685 lbs 0.57 tons	445.94 64.75										
TOTAL							$72.73						$205.20	$132.47

Part B- Future Conditions (2041)

	Without Project							With Project						
Land Use	Price	Percent Distribution 1/	Yield Per Acre	Gross Value	Production Costs	Net Return	Weighted Net Value Without Project	Percent Distribution	Yield Per Acre	Gross Value	Production Costs	Net Returns	Weighted Net Value With Project	Increase In Net Productive Value Per Acre
Soybeans	$7.45/bu	50	49 bu	$365.05	$135.85	$229.20	$114.60	0					$0.00	$-114.60
Beans/Wheat Double Crop	7.45/bu	16	47 bu	350.15	109.53	240.62	38.50	84	56 bu	417.20	109.53	307.67	258.44	219.94
Wheat/Beans Double Crop	3.88/bu	16	55 bu	213.40	74.52	138.88	22.22	84	64 bu	248.32	74.52	173.80	145.99	123.77
Pasture	68.61/cwt	23	10.01 cwt	686.79	281.99	404.80	93.10	8	10.01 cwt	686.79	281.99	404.80	32.38	-60.72
Grain Sorghum	5.04/cwt	10	56.9 cwt	283.78	147.72	139.06	13.91	8	58.9 cwt	296.86	147.72	149.14	11.93	-1.98
Cotton		1			331.31	367.94	3.68	0					0.00	-3.68
Lint Seed	0.651/1b 113.60/ton		938 lbs 0.78 tons	610.64 88.61										
TOTAL							$286.01						$448.72	$162.73

TABLE D-4-13

INTENSIFICATION BENEFITS

Aloha-Rigolette Area

A. Flood Damage Remaining:

Plan	Damage per Flood Peak Acre 1/ ($)		Average Annual Acres Flooded 2/ (ac.)		Percent Subject to Change in Cropping Patterns (%)		Flood Damage ($)
(1) With-Project Conditions, With-Project Yield Levels							
Du Grappe Reach							
5/19	41.23	x	1,582	x	.20	=	13,045
6	41.23	x	420	x	.20	=	3,463
9_1	41.23	x	1,822	x	.20	=	15,024
9_2	41.23	x	1,822	x	.20	=	15,024
9_3	41.23	x	789	x	.20	=	6,506
9_4	41.23	x	1,130	x	.20	=	9,318
20	41.23	x	1,283	x	.20	=	10,580
5/19	39.76	x	2,253	x	.11	=	9,854
6	39.76	x	806	x	.11	=	3,525
9_1	39.76	x	2,560	x	.11	=	11,196
9_2	39.76	x	2,109	x	.11	=	9,224
9_3	39.76	x	2,109	x	.11	=	9,224
9_4	39.76	x	2,650	x	.11	=	11,590
20	39.76	x	2,980	x	.11	=	13,033
(2) With-Project Conditions, Without-Project Yield Levels							
5/19	26.66	x	1,582	x	.20	=	8,435
6	26.66	x	420	x	.20	=	2,239
9_1	26.66	x	1,822	x	.20	=	9,715
9_2	26.66	x	1,822	x	.20	=	9,715
9_3	26.66	x	789	x	.20	=	4,207
9_4	26.66	x	1,130	x	.20	=	6,025
20	26.66	x	1,283	x	.20	=	6,814
5/19	30.82	x	2,253	x	.11	=	7,638
6	30.82	x	806	x	.11	=	2,733
9_1	30.82	x	2,560	x	.11	=	8,679
9_2	30.82	x	2,109	x	.11	=	7,150
9_3	30.82	x	2,109	x	.11	=	7,150
9_4	30.82	x	2,650	x	.11	=	8,984
20	30.82	x	2,980	x	.11	=	10,103

(3) Increase in Damages

Plan	Damages With Increased Yields ($)		Damages Without Increased Yields ($)		Increase in Damages ($)
Du Grappe Reach					
5/19	13,045	-	8,435	=	4,610
6	3,463	-	2,239	=	1,224
9_1	15,024	-	9,715	=	5,309
9_2	15,024	-	9,715	=	5,309
9_3	6,506	-	4,207	=	2,299
9_4	9,318	-	6,025	=	3,293
20	10,580	-	6,841	=	3,739
Rigolette Reach					
5/19	9,854	-	7,638	=	2,216
6	3,525	-	2,733	=	792
9_1	11,196	-	8,679	=	2,517
9_2	9,224	-	7,150	=	2,074
9_3	9,224	-	7,150	=	2,074
9_4	11,590	-	8,984	=	2,606
20	13,033	-	10,103	=	2,930

B. Total Annual Benefits - Existing

Plan	Increase In Productive Value of Area 3/ ($)	Increase in Damages ($)		Percentage of Damages Prevented (%)		Average Annual Benefits ($)
Du Grappe Reach						
5/19	50,242	4,610	x	0.13	=	5,932
6	107,410	1,224	x	0.77	=	81,763
9_1	47,850	5,309	x	0.00	=	0
9_2	47,850	5,309	x	0.00	=	0
9_3	78,826	2,299	x	0.57	=	43,620
9_4	63,338	3,293	x	0.38	=	22,817
20	58,301	3,739	x	0.30	=	16,369
Rigolette Reach						
5/19	298,587	2,216	x	0.53	=	151,077
6	304,813	792	x	0.83	=	252,337
9_1	301,237	2,517	x	0.46	=	137,411
9_2	301,899	2,074	x	0.56	=	167,902
9_3	301,899	2,074	x	0.56	=	167,902
9_4	299,647	2,606	x	0.44	=	130,698
20	288,785	2,930	x	0.37	=	105,766

TABLE D-4-13 (continued)

C. Total Annual Benefits - Future

Plan	Increase In Productive Value of Area 3/ ($)	Increase in Damages ($)		Percentage of Damages Prevented 4/ (%)		Average Annual Benefits ($)
Du Grappe Reach						
5/19	39,900	4,610	x	0.13	=	4,588
6	85,300	1,224	x	0.77	=	64,739
9_1	38,000	5,309	x	0.00	=	0
9_2	38,000	5,309	x	0.00	=	0
9_3	62,600	2,299	x	0.57	=	34,372
9_4	50,300	3,293	x	0.38	=	17,863
20	46,300	3,739	x	0.30	=	12,768
Rigolette Reach						
5/19	366,793	2,216	x	0.53	=	193,226
6	374,442	792	x	0.83	=	310,130
9_1	370,048	2,517	x	0.46	=	169,064
9_2	370,862	2,074	x	0.56	=	206,521
9_3	370,862	2,074	x	0.56	=	206,521
9_4	368,095	2,606	x	0.44	=	160,815
20	354,751	2,930	x	0.37	=	130,174

D. Present Value

Plan	Existing Benefit ($)	Future Benefit ($)	Present Value (Average Annual Equivalent) ($)
Du Grappe Reach			
5/19	5,932	4,588	5,552
6	81,763	64,739	76,955
9_1	0	0	0
9_2	0	0	0
9_3	43,620	34,372	41,009
9_4	22,817	17,863	21,418
20	16,369	12,768	15,352
Rigolette Reach			
5/19	157,077	193,226	175,466
6	252,337	310,130	281,736
9_1	137,411	169,064	153,512
9_2	167,902	206,521	187,547
9_3	167,902	206,521	187,547
9_4	130,698	160,815	146,018
20	105,766	134,174	118,181

1/ From CACFDAS program
2/ Date from Table D-3-6
3/ Data from Table D-4-6
4/ Data from Table D-4-8

TABLE D-4-14

SUMMARY OF INTENSIFICATION BENEFITS
Aloha-Rigolette Area

River	Alternative 5/19	6	9_1	9_2	9_3	9_4	20
	($)	($)	($)	($)	($)	($)	($)
Du Grappe	5,552	76,955	0	0	41,009	21,418	15,352
Rigolette	175,466	281,736	153,512	187,547	187,547	146,018	118,181
TOTAL	181,018	358,691	153,512	187,547	228,556	167,436	133,533
Rounded	181,000	359,000	154,000	188,000	229,000	167,000	134,000

TABLE D-4-15

AVERAGE ANNUAL BENEFIT SUMMARY
Aloha-Rigolette Area

Benefit Category	Alternative 5/19	6	9_1	9_2	9_3	9_4	20
	($)	($)	($)	($)	($)	($)	($)
Damage Reduction							
Crop 1/	685,000	1,240,000	585,000	714,000	807,000	607,000	460,000
Non Crop 2/	100,000	105,000	64,000	66,000	90,000	89,000	84,000
Intensification 3/	181,000	359,000	154,000	188,000	229,000	167,000	134,000
TOTAL	966,000	1,704,000	803,000	968,000	1,126,000	863,000	678,000

1/ From Table D-4-9
2/ From Table D-4-10
3/ From Table D-4-14

SECTION 5. ANNUAL COSTS AND BENEFITS

COSTS

D.5.1. First costs and annual charges for the six alternatives are shown in Table D-5-1. All costs are based on January 1985 price levels. Net investment was based on the mid-year present value of first costs assuming an interest rate of 8 3/8 percent and a 50-year amortization period. Project base years were 1991 for Plans 9_1, 9_2, 9_3, and 9_4, 1992 for Plans 19 and 20, 1993 for Plan 5, and 1994 for Plan 6.

D.5.2. Discussions with Soil Conservation Service (SCS) personnel revealed that project implementation would necessitate increased on-farm drainage in order to obtain increased agricultural crop yields. SCS estimates that 12,000 acres in Grant Parish and 3,500 acres in Rapides Parish would require additional on-farm drainage. Current estimates indicate the need for approximately 50 feet of drainage per acre at a cost of $0.47 per linear foot. This yields a total cost of $364,000 (Grant: 12,000 acres x 50 ft./ac. x $0.47 = $282,000; Rapides: 3,500 x 50 ft./ac. x $0.47 - $82,250, $82,000 rounded). Applying the current Federal discount rate of 8 3/8 percent and a 50-year amortization period yields an average annual cost of $30,000 ($364,000 x .08528 = $31,042, $31,000 rounded).

ECONOMIC JUSTIFICATION

D.5.3. Project first costs, annual benefits and costs, excess benefits over costs, and benefit-to-cost ratios for each plan are presented in Table D-5-2.

TABLE D-5-1

FIRST COSTS AND ANNUAL CHARGES

Aloha-Rigolette Area

Item	Alternative 5	6	9_1	9_2	9_3	9_4	19	20
	($)	($)	($)	($)	($)	($)	($)	($)
First Costs								
Construction Cost	5,620,000	11,000,000	7,390,000	8,810,000	9,350,000	7,350,000	7,000,000	35,400,000
Present Value of Investment	6,055,570	13,665,268	7,955,120	9,486,025	10,107,446	7,865,013	7,754,668	37,169,014
Annual Costs								
Interest (.08375)	507,000	1,144,000	666,000	794,000	846,000	659,000	649,000	3,113,000
Amortization (.00153)	9,000	21,000	12,000	15,000	15,000	12,000	12,000	57,000
Operation and Maintenance	13,000	48,000	45,000	73,000	88,000	35,000	13,000	798,000
On Farm Drainage	31,000	31,000	31,000	31,000	31,000	31,000	31,000	31,000
Total Annual Charges	560,000	1,244,000	754,000	913,000	980,000	737,000	705,000	3,999,000

TABLE D-5-2

FIRST COSTS, ANNUAL BENEFITS, ANNUAL COSTS,
EXCESS BENEFITS OVER COSTS, AND BENEFIT-TO-COST RATIOS

Aloha-Rigolette Area

Item	Alternative							
	5	6	9_1	9_2	9_3	9_4	19	20
	($)	($)	($)	($)	($)	($)	($)	($)
First Costs	5,620,000	11,000,000	7,390,000	8,810,000	9,350,000	7,350,000	7,000,000	35,400,000
Annual Benefits	966,000	1,704,000	803,000	968,000	1,126,000	863,000	966,000	678,000
Annual Costs	560,000	1,244,000	754,000	913,000	980,000	737,000	705,000	3,999,000
Excess Benefits over Costs	406,000	460,000	49,000	55,000	146,000	126,000	261,000	0
Benefit-to-Cost Ratio	1.72	1.37	1.06	1.06	1.15	1.17	1.37	0.15

PLANS SELECTED FOR DETAILED STUDY (D.S.P.)

D.5.4. Plans 5, 6, and 19 have been designated as the plans selected for further evaluation. The rationale for selection and non-selection of plans for detailed study is discussed in Appendix A, Plan Formulation.

SECTION 6. MAXIMIZATION OF NET BENEFITS

GENERAL

D.6.1. Three plans were analyzed in detail and were scaled to maximize benefits over costs. These were 5, 6, and 19. Three levels of flood protection were investigated for Plan 19 and four levels of protection were examined for Plans 5 and 6. Plan 5, as originally analyzed, considered the addition of four floodgates. This plan will now be called 5B. Plan 5A considered the addition of two floodgates, Plan 5C the addition of six floodgates, and Plan 5D the addition of eight floodgates. Plans 19A, 19B, and 19C consist of the same number of floodgates described in Plans 5A, 5B, and 5C, respectively, with "no development" easements over all wooded lands within the with-project 5-year overflow area. Plan 6, as originally formulated, included five floodgates located at Bayou Darrow and 23.2 miles of channel modification. This plan will now be called Plan 6B. Plan 6A considers channel modification to a greater degree than 6B in addition to four floodgates. Plan 6C considers clearing and snagging in addition to six floodgates and Plan 6D clearing and snagging in addition to seven floodgates.

DAMAGE REDUCTION BENEFITS - CROP

D.6.2. In order to determine the crop damages associated with each alternative, stage-area curves (Figures D-3 and D-4) were derived using the annual duration stage-frequency relationships for the respective alternatives. Then, using the damage rates per cleared acre for existing and future development, expected annual crop damages for all alternatives were derived. The increases in net income as measured by farm budget analyses were determined. These analyses are delineated in Tables D-6-1 through D-6-8. The average annual damage reduction benefits to agriculture are shown in Table D-6-9.

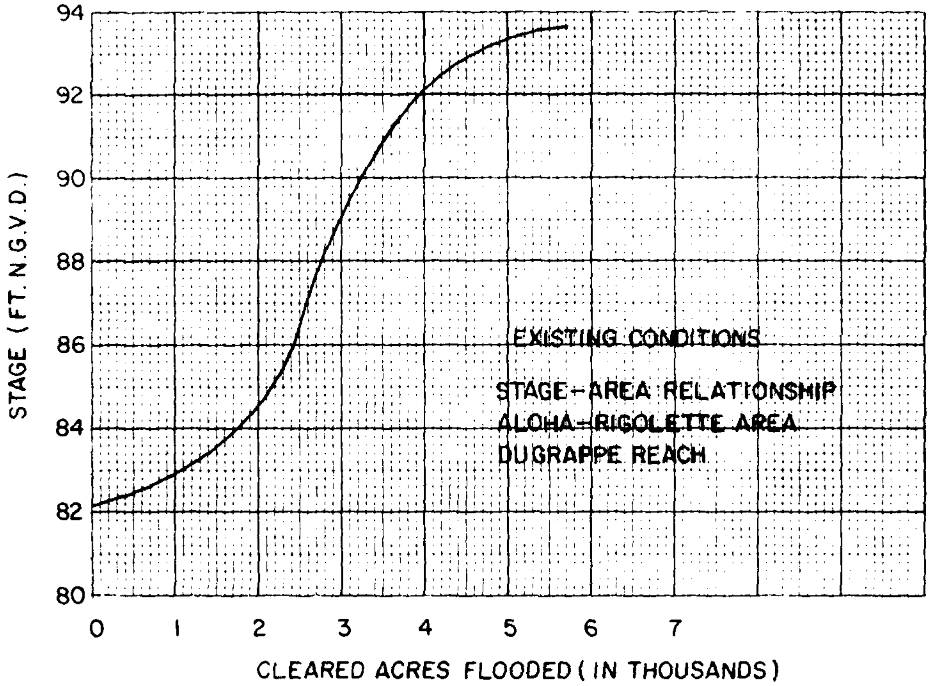


FIGURE D-3

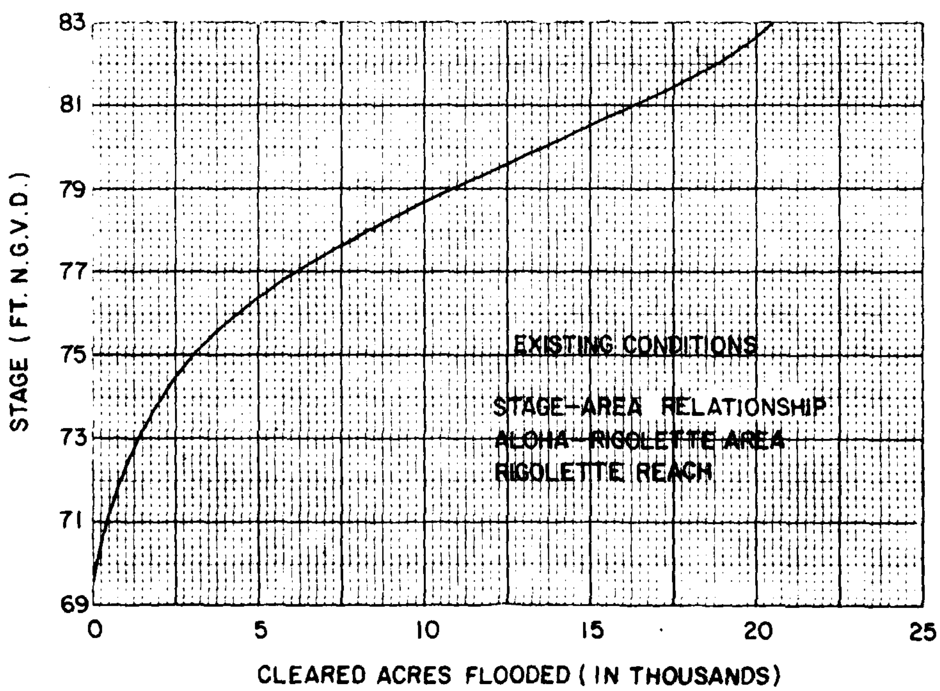


FIGURE D-4

TABLE D-6-1

CLEARED ACREAGE FLOODED, D.S.P. 1/

Aloha-Rigolette Area

Plan	Without-Project 3-year Overflow	Without-Project 10-year Overflow	Without-Project 100-year Overflow	Without-Project Annual Overflow	With-Project 3-year Overflow	With-Project 10-year Overflow	With-Project 100-year Overflow	With-Project Annual Overflow	With-Project Average Annual Acres Protected
Du Grappe Reach									
5A, B, C, and D and 19A, B, and C	2,367	2,839	4,265	1,822	2,270	2,800	4,265	1,582	240
6A	2,367	2,839	4,265	1,822	0	1,300	2,770	355	1,467
6B	2,367	2,839	4,265	1,822	0	1,700	2,770	420	1,402
6C & 6D	2,367	2,839	4,265	1,822	200	2,350	2,800	567	1,255
Rigolette Reach									
5A & 19A	4,129	12,621	20,921	4,753	850	8,500	20,375	2,736	2,017
5B & 19B	4,129	12,621	20,921	4,753	350	5,500	20,125	2,253	2,500
5C & 19C	4,129	12,621	20,921	4,753	225	4,000	19,500	1,729	3,024
5D	4,129	12,621	20,921	4,753	33	2,900	18,500	1,459	3,294
6A, B, C, and D	4,129	12,621	20,921	4,753	0	1,000	13,950	806	3,947

SOURCE: New Orleans District

1/ Detailed Study Plans

TABLE D-6-2

AVERAGE ANNUAL CROP DAMAGES, D. S. P.
Aloha-Rigolette Area

Plan	Du Grappe Reach			Rigolette Reach		
	Cleared Acres	Damage/Flood Peak Acre 1/	Average Annual Crop Damages	Cleared Acres	Damage/Flood Peak Acre 1/	Average Annual Crop Damages
Without Project	1,822	$26.66	$48,575	4,753	$30.82	$146,487
With Project						
5A & 19A	1,582	26.66	42,176	2,736	30.82	84,324
5B & 19B	1,582	26.66	42,176	2,253	30.82	69,437
5C & 19C	1,582	26.66	42,176	1,729	30.82	53,288
5D	1,582	26.66	42,176	1,459	30.82	44,966
6A	355	26.66	9,464	806	30.82	24,841
6B	420	26.66	11,197	806	30.82	24,841
6C & D	567	26.66	15,116	806	30.82	24,841

SOURCE: Gulf South Research Development Corporation

1/ Without intensified land use for with-project plans. Data from CACFDAS program.

TABLE D-6-3

DAMAGE REDUCTION BENEFITS, D.S.P.
EXISTING AGRICULTURAL PRODUCTION
(January 1985 Price Levels)

Aloha-Rigolette Area

Plan	Agricultural Damages Without-Project	Agricultural Damages With-Project	Damage Reduction Benefit
	($)	($)	($)
Du Grappe Reach			
5A, B, C, D, and 19A, B, C	48,575	42,176	6,399
6A	48,575	9,464	39,111
6B	48,575	11,197	37,378
6C and D	48,575	15,116	33,456
Rigolette Reach			
5A & 19A	146,487	84,324	62,163
5B & 19B	146,487	69,437	77,050
5C & 19C	146,487	53,288	93,199
5D	146,487	44,966	101,521
6A, B, C, and D	146,487	24,841	121,646

TABLE D-6-4

ACREAGE SUBJECT TO INCREASED NET RETURNS, D.S.P.

Aloha-Rigolette Area

Alternative	100-Year Frequency W/O Project	3-Year Frequency With Project	Subject to Increased Net Returns	Increased Yield Portion 1/	Distribution Change Portion 2/
	(ac)	(ac)	(ac)	(ac)	(ac)
Du Grappe Reach					
5A, B, C, D and 19A, B, and C	4,265	2,270	1,995	1,596	399
6A	4,265	0	4,265	3,412	853
6B	4,265	0	4,265	3,412	853
6C & D	4,265	200	4,065	3,252	813
Rigolette Reach					
5A & 19A	20,921	850	20,071	17,863	2,208
5B & 19B	20,921	350	20,571	18,317	2,254
5C & 19C	20,921	225	20,696	18,419	2,277
5D	20,921	33	20,888	18,590	2,298
6A, B, C, and D	20,921	0	20,921	18,620	2,301

1/ 2/ See footnotes, Table D-4-4

TABLE D-6-5

INCREASE IN THE PRODUCTIVE VALUE OF THE AREA, D.S.P.

(No Change in Cropping Pattern)

Aloha-Rigolette Area

Alternative	Subject to Increased Net Returns	Existing: Increase in the Productive Value	Existing: Total Increase	Future: Increase in the Productive Value	Future: Total Increase
	(ac)	(ac)	(ac)	(ac)	(ac)
Du Grappe Reach					
5A, B, C, D and 19A, B, and C	1,596	45.17	72,091	52.36	83,567
6A	3,412	45.17	154,120	52.36	178,652
6B	3,412	45.17	154,120	52.36	178,652
6C & D	3,252	45.17	146,893	52.36	170,275
Rigolette Reach					
5A & 19A	17,863	51.24	915,300	72.88	1,301,855
5B & 19B	18,317	51.24	938,563	72.88	1,334,943
5C & 19C	18,419	51.24	943,790	72.88	1,342,377
5D	18,590	51.24	952,552	72.88	1,354,839
6A, B, C, and D	18,620	51.24	954,089	72.88	1,357,026

TABLE D-6-6

INCREASE IN THE PRODUCTIVE VALUE OF THE AREA, D.S.P.

(Changes in Cropping Pattern)

Aloha-Rigolette Area

Alternative	Subject to Increased Net Returns	Existing: Increase in the Productive Value	Existing: Total Increase	Future: Increase in the Productive Value	Future: Total Increase
	(ac)	(ac)	(ac)	(ac)	(ac)
Du Grappe Reach					
5A, B, C, D and 19A, B, and C	399	125.92	50,242	100.00	39,900
6A	853	125.92	107,410	100.00	85,300
6B	853	125.92	107,410	100.00	85,300
6C & D	813	125.92	102,373	100.00	81,300
Rigolette Reach					
5A & 19A	2,208	132.47	292,494	162.73	359,308
5B & 19B	2,254	132.47	298,587	162.73	366,793
5C & 19C	2,277	132.47	301,634	162.73	370,536
5D	2,298	132.47	304,416	162.73	373,954
6A, B, C, and D	2,301	132.47	304,813	162.73	374,442

TABLE D-6-7

PERCENTAGE OF DAMAGE PREVENTED, D.S.P.

Aloha-Rigolette Area

Plan	Damages Prevented 1/	Damages Without-Project	Percentage of Damages Prevented
DuGrappe Reach			
5A, B, C, D, & 19A, B, C	6,399	48,575	13
6A	39,111	48,575	81
6B	37,378	48,575	77
6C & D	33,459	48,575	69
Rigolette Reach			
5A & 19A	62,163	146,487	42
5B & 19B	77,050	146,487	53
5C & 19C	93,199	146,487	64
5D	101,521	146,487	69
6A, B, C, and D	121,646	146,487	83

1/ Based on acreages protected prior to removing areas from agricultural production for project mitigation purposes.

TABLE D-6-8

DAMAGE REDUCTION BENEFITS, D.S.P.

-INCREASED YIELDS-

Aloha-Rigolette Area

A. FLOOD DAMAGE REMAINING:

(1) With-Project Conditions, With-Project Yield Levels

Plan	Damage per Flood Peak Acre ($)		Average Annual Acres Flooded (ac.)		Percent Subject to Increased Yields Only (%)		Flood Damage ($)
DuGrappe Reach							
5A, B, C, D and 19A, B, C	41.23	x	1,582	x	.80	=	52,181
6A	41.23	x	355	x	.80	=	11,709
6B	41.23	x	420	x	.80	=	13,853
6C & D	41.23	x	567	x	.80	=	18,702
Rigolette Reach							
5A & 19A	39.76	x	2,736	x	.89	=	96,817
5B & 19B	39.76	x	2,253	x	.88	=	79,726
5C & 19C	39.76	x	1,729	x	.88	=	61,183
5D	39.76	x	1,459	x	.88	=	51,629
6A, B, C, D	39.76	x	806	x	.89	=	28,521

(2) With-Project Conditions, Without-Project Yield Levels

Plan	Damage per Flood Peak Acre ($)		Average Annual Acres Flooded (ac.)		Percent Subject to Increased Yields Only (%)		Flood Damage ($)
DuGrappe Reach							
5A, B, C, D and 19A, B, C	26.66	x	1,582	x	.80	=	33,741
6A	26.66	x	355	x	.80	=	7,571
6B	26.66	x	420	x	.80	=	8,958
6C & D	26.66	x	567	x	.80	=	12,093
Rigolette Reach							
5A & 19A	30.82	x	2,736	x	.89	=	75,048
5B & 19B	30.82	x	2,253	x	.89	=	61,799
5C & 19C	30.82	x	1,729	x	.89	=	47,426
5D	30.82	x	1,459	x	.89	=	40,020
6A, B, C, D	30.82	x	806	x	.89	=	22,108

(3) Increase in Damages

Plan	Damages With Increased Yields ($)		Damages Without Increased Yields ($)		Increase in Damages ($)
DuGrappe Reach					
5A, B, C, D and 19A, B, C	52,181	-	33,741	=	18,440
6A	11,709	-	7,571	=	4,138
6B	13,853	-	8,958	=	4,895
6C & D	18,702	-	12,093	=	6,609
Rigolette Reach					
5A & 19A	96,817	-	75,048	=	21,769
5B & 19B	79,726	-	61,799	=	17,927
5C & 19C	61,183	-	47,426	=	13,757
5D	51,629	-	40,020	=	11,609
6A, B, C, D	28,521	-	22,108	=	6,413

B. TOTAL ANNUAL BENEFITS - EXISTING

Plan	Increase in Productive Value of Area ($)		Increase in Damages ($)		Percentage of Damages Prevented (%)		Average Annual Benefits ($)
DuGrappe Reach							
5A, B, C, D and 19A, B, C	72,091	-	18,440	x	0.13	=	6,975
6A	154,120	-	4,138	x	0.81	=	121,485
6B	154,120	-	4,895	x	0.77	=	114,903
6C & D	146,893	-	6,609	x	0.69	=	96,796
Rigolette Reach							
5A & 19A	915,300	-	21,769	x	0.42	=	375,283
5B & 19B	938,563	-	17,927	x	0.53	=	487,937
5C & 19C	943,790	-	13,757	x	0.64	=	595,221
5D	952,552	-	11,609	x	0.69	=	649,251
6A, B, C, D	954,089	-	6,413	x	0.83	=	786,571

TABLE D-6-8 (Continued)

DAMAGE REDUCTION BENEFITS, D.S.P.

-INCREASED YIELDS-

Aloha-Rigolette Area

C. TOTAL ANNUAL BENEFITS - FUTURE

Plan	Increase in Productive Value of Area ($)		Increase in Damages ($)		Percentage of Damages Prevented (%)		Average Annual Benefits ($)
DuGrappe Reach							
5A, B, C, D							
and 19A, B, C	83,567	-	18,440	x	0.13	=	8,467
6A	178,652	-	4,138	x	0.81	=	141,356
6B	178,652	-	4,895	x	0.77	=	133,793
6C & D	170,275	-	6,609	x	0.69	=	112,930
Rigolette Reach							
5A & 19A	1,301,855	-	21,769	x	0.42	=	537,636
5B & 19B	1,334,943	-	17,927	x	0.53	=	698,018
5C & 19C	1,342,377	-	13,757	x	0.64	=	850,317
5D	1,354,839	-	11,609	x	0.69	=	926,829
6A, B, C, D	1,357,026	-	6,413	x	0.83	=	1,121,069

D. PRESENT VALUE

Plan	Existing Benefit ($)	Future Benefit ($)	Present Value (Average Annual Equivalent) ($)
DuGrappe Reach			
5A, B, C, D			
and 19A, B, C	6,975	8,467	7,734
6A	121,485	141,356	131,594
6B	114,903	133,793	124,513
6C & D	96,796	112,930	105,003
Rigolette Reach			
5A & 19A	375,283	537,636	457,870
5B & 19B	487,937	698,018	594,803
5C & 19C	595,221	850,317	724,986
5D	649,251	926,829	790,452
6A, B, C, D	786,571	1,121,069	956,727

TABLE D-6-9

AVERAGE ANNUAL DAMAGE REDUCTION BENEFITS, D.S.P. - AGRICULTURE

Aloha-Rigolette Area

Reach	5A & 19A	5B & 19B	5C & 19C	5D	6A	6B	6C & D
Reduced Flood Damage							
DuGrappe Reach	6,399	6,399	6,399	6,399	39,111	37,378	33,456
Rigolette Reach	62,163	77,050	93,199	101,521	121,521	121,521	121,521
TOTAL	68,562	83,449	99,598	107,920	160,632	158,899	154,977
Rounded	(69,000)	(83,000)	(100,000)	(108,000)	(161,000)	(159,000)	(155,000)
Increased Yields							
DuGrappe Reach	7,734	7,734	7,734	7,734	131,594	124,513	105,003
Rigolette Reach	457,870	594,803	724,986	790,452	956,727	956,727	956,727
TOTAL	465,604	602,537	732,720	798,186	1,088,321	1,081,240	1,061,730
Rounded	(466,000)	(603,000)	(733,000)	(798,000)	(1,088,000)	(1,081,000)	(1,062,000)
TOTAL AVERAGE ANNUAL DAMAGE REDUCTION BENEFITS	535,000	686,000	833,000	906,000	1,249,000	1,240,000	1,217,000

D.6.3. Subsequent to the above analysis, the effects of using partial duration or annual duration series stage-frequency relationships were analyzed. The results yielded a net change in benefits of less than 1.3 percent. While the flood damages reduced would increase by approximately 12.1 percent, this represents only 10-15 percent of the total benefit package. Benefits to be derived from increased yields and from changes in cropping patterns, which represent 85-90 percent of the total benefits, would decrease by 3.6 percent. It was, therefore, decided that a reanalysis based on partial duration stage-frequency relationships would not be necessary due to the very minimal impact on the overall project analysis.

DAMAGE REDUCTION BENEFITS - NONCROP

D.6.4. In order to determine the noncrop flood damages prevented, stage damage relatiaonships (Figures D-5 and D-6) were developed to reflect the differing levels of expected flooding. These damages and the average annual benefits are shown in Table D-6-10.

INTENSIFICATION BENEFITS

D.6.5. Intensification benefits were computed for the alternatives. Table D-6-11 shows these computations and Table D-6-12 summarizes the project intensification benefits.

D.6.6. Although additional development for agricultural purposes may occur over the life of the project, this development would occur either with or without the project and is, therefore, not considered to be induced development. Currently, some 75 percent of the land in the project area is devoted to agricultural production. This percentage holds relatively constant for lands above the 100-year flowline, for lands between the 3-year and 100-year flowlines, and for lands below the 3-year flowline. Interviews with major landholders in the area indicate that no clearing has taken place in anticipation of any Federal flood control project.

Additionally, any future clearing that may occur will be due to the agricultural economic climate. A favorable return on investment is required due to the high cost of land clearing. Major clearing did occur during the mid-1950's and the 1970's. However, this clearing was due to technological advances in the 1950's that allowed for the preparation of lands for farming that previously had been too clayey to work, and to the favorable economic return on soybeans in the 1970's.

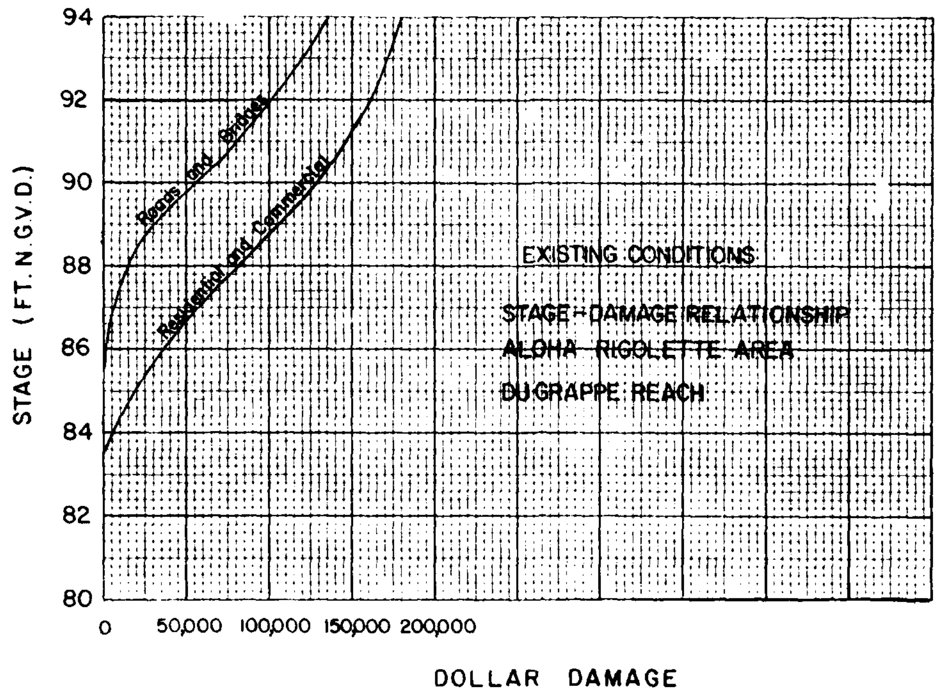


FIGURE D-5

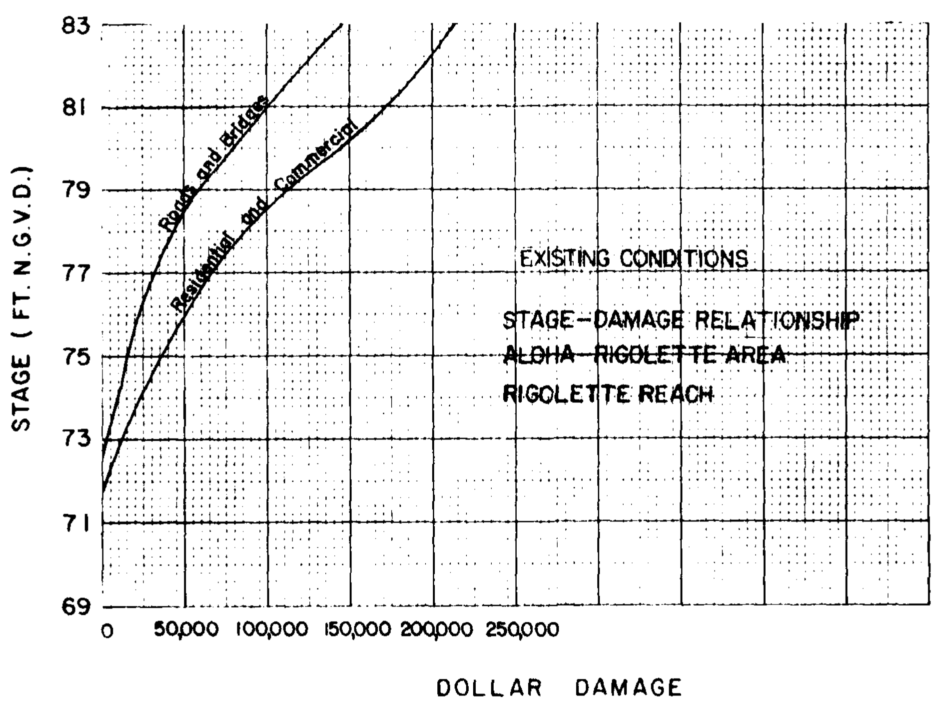


FIGURE D-6

TABLE D-6-10

DAMAGE REDUCTION BENEFITS - NON-CROP, D.S.P.

Aloha-Rigolette Area

Reach/Damage Category	ALTERNATIVE 5A & 19A	5B & 19B	5C & 19 C	5D	6A	6B	6C & D
DuGrappe Reach							
-Without Project-							
Residential and Commercial	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Roads and Bridges	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Average Annual Damages	39,000	39,000	39,000	39,000	39,000	39,000	39,000
-With Project-							
Residential and Commercial	3,000	3,000	3,000	3,000	1,000	1,000	2,000
Roads and Bridges	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Residual Average Annual Damages	4,000	4,000	4,000	4,000	2,000	2,000	3,000
Net Average Annual Benefits	35,000	35,000	35,000	35,000	37,000	37,000	36,000
Rigolette Reach							
-Without Project-							
Residential and Commercial	46,000	46,000	46,000	46,000	46,000	46,000	46,000
Roads and Bridges	24,000	24,000	24,000	24,000	24,000	24,000	24,000
Average Annual Damages	70,000	70,000	70,000	70,000	70,000	70,000	70,000
-With Project-							
Residential and Commercial	6,000	3,000	2,000	1,000	1,000	1,000	1,000
Roads and Bridges	3,000	2,000	1,000	1,000	1,000	1,000	1,000
Residual Average Annual Damages	9,000	5,000	3,000	2,000	2,000	2,000	2,000
Net Average Annual Benefits	61,000	65,000	67,000	68,000	68,000	68,000	68,000
TOTAL AVERAGE ANNUAL BENEFITS	96,000	100,000	102,000	103,000	105,000	105,000	104,000

TABLE D-6-11

INTENSIFICATION BENEFITS, D.S.P.

Aloha Rigolette Area

A. Flood Damage Remaining:

Plan	Damage Per Flood Peak Acre ($)		Average Annual Acres Flooded (ac.)		Percent Subject to Change in Cropping Patterns (%)		Flood Damage ($)
(1) With-Project Conditions, With-Porject Yield Levels.							
DuGrappe Reach							
5A, B, C, D and 19A, B, C	41.23	x	1,582	x	.20	=	13,045
6A	41.23	x	355	x	.20	=	2,927
6B	41.23	x	420	x	.20	=	3,463
6C & D	41.23	x	567	x	.20	=	4,675
Rigolette Reach							
5A & 19A	39.76	x	2,736	x	.11	=	11,966
5B & 19B	39.76	x	2,253	x	.11	=	9,854
5C & 19C	39.76	x	1,729	x	.11	=	7,562
5D	39.76	x	1,459	x	.11	=	6,381
6A, B, C, D	39.76	x	806	x	.11	=	3,525
(2) With-Project Conditions, Without-Project Yield Levels							
DuGrappe Reach							
5A, B, C, D and 19A, B, C	26.66	x	1,582	x	.20	=	8,435
6A	26.66	x	355	x	.20	=	1,893
6B	26.66	x	420	x	.20	=	2,239
6C & D	26.66	x	567	x	.20	=	3,023
Rigolette Reach							
5A & 19A	30.82	x	2,736	x	.11	=	9,276
5B & 19B	30.82	x	2,253	x	.11	=	7,638
5C & 19C	30.82	x	1,729	x	.11	=	5,862
5D	30.82	x	1,459	x	.11	=	4,946
6A, B, C, D	30.82	x	806	x	.11	=	2,733

TABLE D-6-11 (Continued)

INTENSIFICATION BENEFITS, D.S.P.

Aloha Rigolette Area

(3) Increase in Damages.

Plan	Damages with Increased Yields ($)		Damages without Increased Yields ($)		Increase in Damages ($)
DuGrappe Reach					
5A, B, C, D, and 19A, B, C	13,045	-	8,435	=	4,610
6A	2,927	-	1,893	=	1,034
6B	3,463	-	2,239	=	1,224
6C & D	4,675	-	3,023	=	1,652
Rigolette Reach					
5A & 19A	11,966	-	9,276	=	2,690
5B & 19B	9,854	-	7,638	=	2,216
5C & 19C	7,562	-	5,862	=	1,700
5D	6,381	-	4,946	=	1,435
6A, B, C, D	3,525	-	2,733	=	792

B. Total Annual Benefits - Existing

Plan ($)	Increase in Productive Value of Area ($)		Increase in Damages (%)		Percentage of Damages Prevented ($)		Average Annual Intensification Benefits
DuGrappe Reach							
5A, B, C, D and 19A, B, C	50,242	-	4,610	x	0.13	=	5,932
6A	107,410	-	1,034	x	0.81	=	86,165
6B	107,410	-	1,224	x	0.77	=	81,763
6C & D	102,373	-	1,652	x	0.69	=	69,497
Rigolette Reach							
5A & 19A	292,494	-	2,690	x	0.42	=	121,718
5B & 19B	298,587	-	2,216	x	0.53	=	157,077
5C & 19C	301,634	-	1,700	x	0.64	=	191,958
5D	304,416	-	1,435	x	0.69	=	209,057
6A, B, C, D	304,813	-	792	x	0.83	=	252,337

TABLE D-6-11 (Continued)

INTENSIFICATION BENEFITS, D.S.P.

Aloha Rigolette Area

C. Total Annual Benefits - Future

Plan ($)	Increase in Productive Value of Area ($)		Increase in Damages (%)		Percentage of Damages Prevented ($)		Average Annual Intensification Benefits
DuGrappe Reach							
5A, B, C, D and 19A, B, C	39,900	-	4,610	x	0.13	=	4,588
6A	85,300	-	1,034	x	0.81	=	68,255
6B	85,300	-	1,224	x	0.77	=	64,739
6C & D	81,300	-	1,652	x	0.69	=	54,957
Rigolette Reach							
5A & 19A	359,308	-	2,690	x	0.42	=	149,780
5B & 19B	366,793	-	2,216	x	0.53	=	193,226
5C & 19C	370,536	-	1,700	x	0.64	=	236,055
5D	373,954	-	1,435	x	0.69	=	257,038
6A, B, C, D	374,442	-	792	x	0.83	=	310,130

D. Present Value

Plan	Existing Benefits ($)	Future Benefits ($)	Present Value (Average Annual Equivalent) ($)
DuGrappe Reach			
5A, B, C, D, and 19A, B, C	5,932	4,588	5,552
6A	86,165	68,255	81,108
6B	81,763	64,739	76,955
6C & D	69,497	54,957	65,391
Rigolette Reach			
5A & 19A	121,718	149,780	133,187
5B & 19B	157,077	193,226	175,466
5C & 19C	191,958	236,055	210,307
5D	209,057	257,038	228,666
6A, B, C, D	252,337	310,130	281,736

TABLE D-6-12

SUMMARY OF INTENSIFICATION BENEFITS, D.S.P.

Aloha-Rigolette Area

	Alternative						
Reach	5A & 19A	5B & 19B	5C & 19C	5D	6A	6B	6C & D
DuGrappe	5,552	5,552	5,552	5,552	81,108	76,955	65,391
Rigolette	133,187	175,466	210,307	228,666	281,736	281,736	281,736
TOTAL	138,739	181,018	215,859	234,218	362,844	358,691	347,127
ROUNDED	(139,000)	(181,000)	(216,000)	(234,000)	(363,000)	(359,000)	(347,000)

TABLE D-6-13

AVERAGE ANNUAL BENEFIT SUMMARY, D.S.P.

Aloha-Rigolette Area

Benefit Category	Alternative							
	5A & 19A	5B & 19B	5C & 19C	5D	6A	6B	6C	6D
	$	$	$	$	$	$	$	$
Damage Reduction								
Crop	535,000	686,000	833,000	906,000	1,249,000	1,240,000	1,217,000	1,217,000
Non-crop	96,000	100,000	102,000	103,000	105,000	105,000	104,000	104,000
Intensification	139,000	181,000	216,000	234,000	363,000	359,000	347,000	347,000
Flood Control Benefits	770,000	967,000	1,151,000	1,243,000	1,717,000	1,704,000	1,668,000	1,668,000
Mitigation Benefits	74,000	74,000	74,000	74,000	81,000	81,000	81,000	81,000
TOTAL BENEFITS	844,000	1,041,000	1,225,000	1,317,000	1,798,000	1,785,000	1,749,000	1,749,000

MITIGATION

D.6.7 Mitigation options for the alternative plans are discussed in Appendix A, Formulation, Assessment, and Evaluation of Detailed Plans. Fish and wildlife losses resulting from project construction, as well as first costs, annual charges, and annual operation and maintenance expenditures for the tentatively selected mitigation plans are shown in Tables D-6-14 and D-6-15. The mitigation plan for Plan 6 consists of two elements:

o Purchase in fee and reforestation of about 600 acres of agricultural lands, resulting in an annual increase in hunting values of $7,000.

o Acquisition of perpetual flowage easements on an additional 100 acres of land subject to flooding from the periodic drawdown of Iatt Lake for purposes of aquatic weed control to help offset losses to fishery resources due to project implementation.

The rejuvenation of Iatt Lake would result in an annual increase of $74,000 in fisheries value. The mitigation for Plans 5 and 19 consists of the acquisition in fee of 170 acres of land below Iatt Lake to permit periodic drawdown for weed control, which would provide for an increase of $74,000 in annual fisheries value. Mitigation benefits are shown on Table D-6-13. Hunting losses due to project construction will amount to $1,000 for Plans 5 and 19, and $36,000 for Plan 6. The annual O&M cost for all mitigation plans is $10,000.

TOTAL FLOOD CONTROL BENEFITS

D.6.8. Total annual flood control benefits resulting from the varying levels of protection for Plans 5, 6, and 19 are shown in Table D-6-13.

SUMMARY

D.6.9. Table D-6-14 displays project first costs and annual charges for the varying sizes of Plans 5, 6, and 19. Table D-6-15 delineates the average annual benefits and costs and the excess benefits over costs for the different levels of protection. Figure D-7 shows the appropriate benefit/cost maximization curves for Plans 5, 6, and 19. All benefits and costs were analyzed using an 8-3/8 percent interest rate, a 50-year project life, and current mid-year present value methodology.

D.6.10. The tentatively selected plan, Plan 5C, maximizes the excess benefits over costs. Project first costs for Plan 5C are $6,900,000 with a present value of $7,861,000 in base year 1993. Average annual costs are $731,000, average annual benefits are $1,225,000, excess benefits over costs are $494,000, and the benefit-to-cost ratio is 1.7 to 1.

TABLE D-6-13

AVERAGE ANNUAL BENEFIT SUMMARY, D.S.P.

Aloha-Rigolette Area

Benefit Category	Alternative						
	5A & 19A	5B & 19B	5C & 19C	5D	6A	6B	6C
	$	$	$	$	$	$	$
Damage Reduction							
Crop	535,000	686,000	833,000	906,000	1,249,000	1,240,000	1,217,000
Non-crop	96,000	100,000	102,000	103,000	105,000	105,000	104,000
Intensification	139,000	181,000	216,000	234,000	363,000	359,000	347,000
Flood Control Benefits	770,000	967,000	1,151,000	1,243,000	1,717,000	1,704,000	1,668,000
Mitigation Benefits	-	-	-	-	81,000	81,000	81,000
TOTAL BENEFITS	770,000	967,000	1,151,000	1,243,000	1,798,000	1,785,000	1,749,000

TABLE D-6-14

FIRST COSTS AND ANNUAL CHARGES, D.S.P.

Aloha-Rigolette Area

Item	Alternative 5A ($)	5B ($)	5C ($)	5D ($)	6A ($)	6B ($)	6C ($)	6D ($)	19A ($)	19B ($)	19C ($)
First Costs - Construction	4,420,000	5,620,000	6,820,000	8,040,000	11,600,000	11,000,000	10,700,000	11,700,000	6,400,000	7,000,000	8,100,000
- Mitigation	80,000	80,000	80,000	80,000	1,720,000	1,580,000	1,500,000	1,500,000	80,000	80,000	80,000
Present Value of Construction Costs	4,919,000	6,056,000	7,784,000	9,060,000	14,254,000	13,665,000	13,181,000	14,413,000	6,935,000	7,755,000	9,307,000
Present Value of Mitigation Costs	77,000	77,000	77,000	77,000	1,588,000	1,459,000	1,385,000	1,385,000	77,000	77,000	77,000
Annual Costs											
Interest (.08375)	412,000	507,000	652,000	759,000	1,194,000	1,144,000	1,104,000	1,207,000	581,000	649,000	779,000
Amortization (.00153)	8,000	9,000	12,000	14,000	22,000	21,000	20,000	22,000	11,000	12,000	14,000
Operation and Maintenance	6,000	13,000	19,000	25,000	39,000	48,000	51,000	57,000	6,000	13,000	19,000
On-Farm Drainage	31,000	31,000	31,000	31,000	31,000	31,000	31,000	31,000	31,000	31,000	31,000
Fish and Wildlife Losses	1,000	1,000	1,000	1,000	36,000	36,000	36,000	36,000	1,000	1,000	1,000
Mitigation Costs											
Interest (.08375)	6,000	6,000	6,000	6,000	133,000	122,000	116,000	116,000	6,000	6,000	6,000
Amortization (.00153)	0[1]	0[1]	0[1]	0[1]	2,000	2,000	2,000	2,000	0[1]	0[1]	0[1]
Operation and Maintenance	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
TOTAL ANNUAL CHARGES	474,000	577,000	731,000	846,000	1,467,000	1,414,000	1,370,000	1,481,000	646,000	722,000	860,000
Base Years	1992	1993	1993	1993	1994	1994	1994	1994	1992	1993	1993

1/ Less than $500.

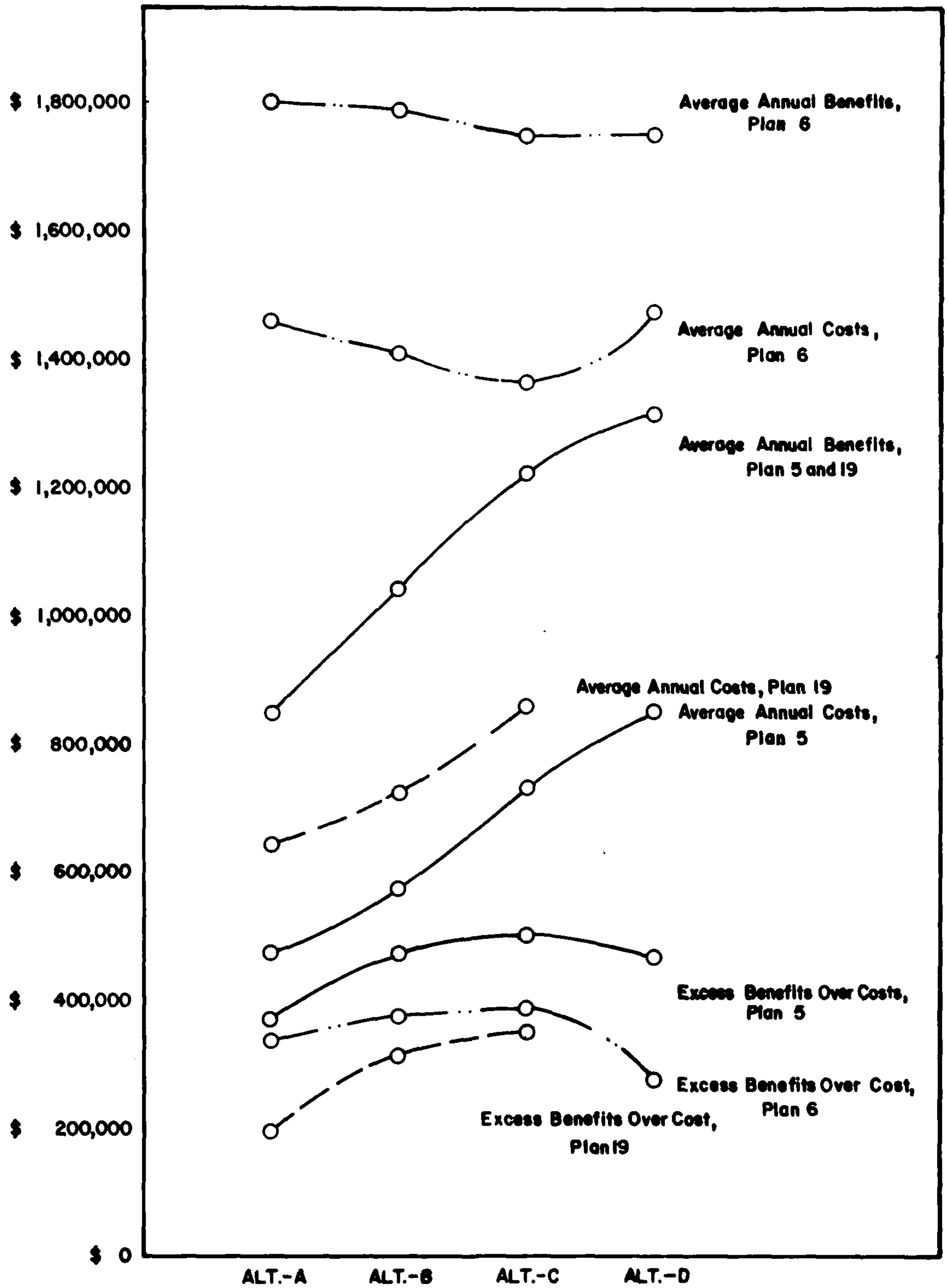
TABLE D-6-15

FIRST COSTS, ANNUAL BENEFITS, ANNUAL COSTS
EXCESS BENEFITS OVER COSTS, AND BENEFIT-TO-COST RATIOS, D.S.P.

Aloha-Rigolette Area

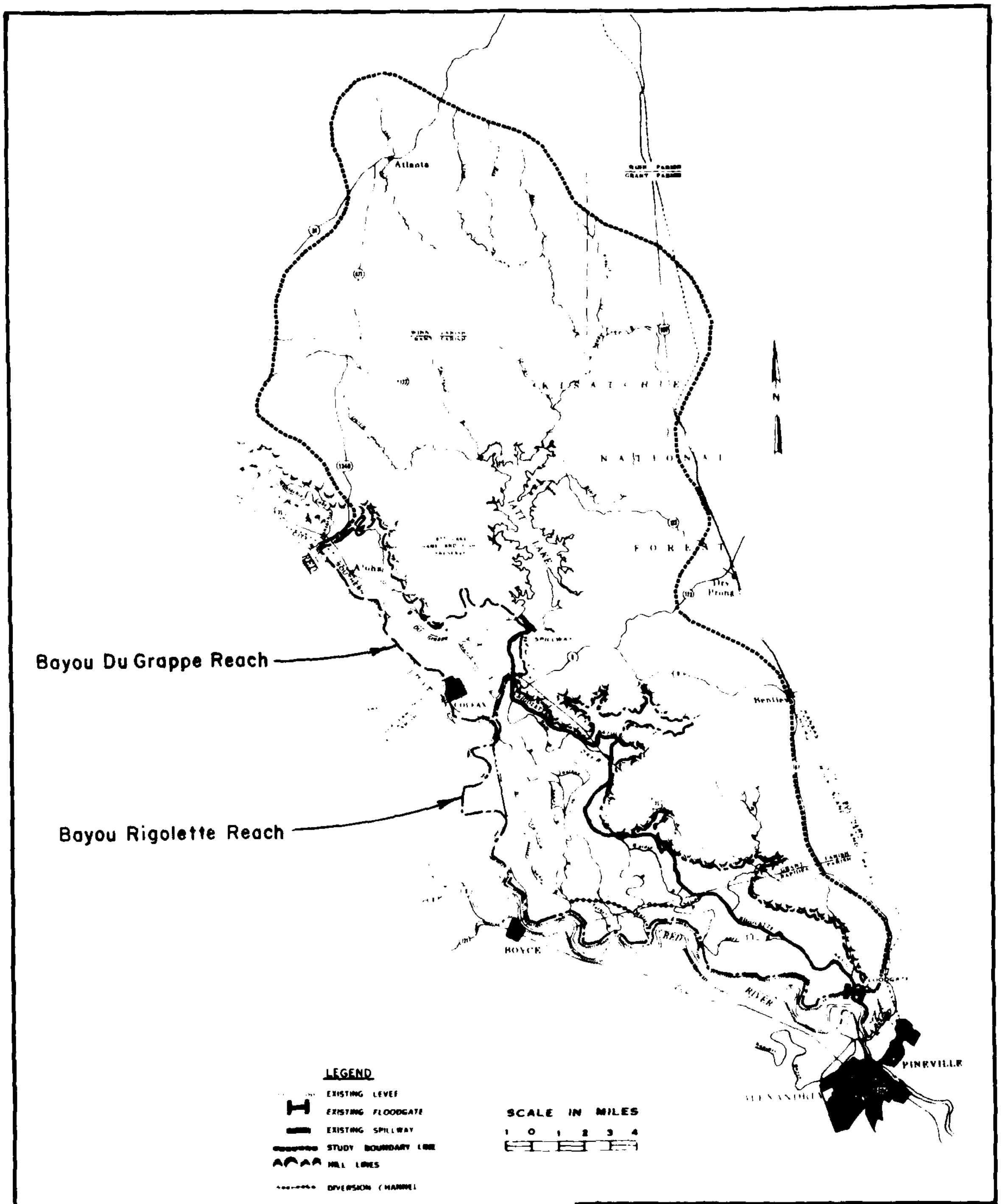
Item	Alternative										
	5A ($)	5B ($)	5C ($)	5D ($)	6A ($)	6B ($)	6C ($)	6D ($)	19A ($)	19B ($)	19C ($)
First Costs*											
Nominal Base Years	4,500,000	5,700,000	6,900,000	8,120,000	13,320,000	12,580,000	12,200,000	13,200,000	6,480,000	7,080,000	8,180,000
Annual Benefits	844,000	1,041,000	1,225,000	1,317,000	1,798,000	1,785,000	1,749,000	1,749,000	844,000	1,041,000	1,225,000
Annual Costs	474,000	577,000	731,000	846,000	1,467,000	1,414,000	1,370,000	1,481,000	646,000	722,000	860 000
Excess Benefits Over Costs	370,000	464,000	494,000	471,000	331,000	371,000	379,000	268,000	198,000	319,000	365,000
Benefit-to-Cost Ratios	1.8	1.8	1.7	1.6	1.2	1.3	1.3	1.2	1.3	1.4	1.4
Common Base Year (1993)											
Annual Benefits	915,000	1,041,000	1,225,000	1,317,000	1,659,000	1,647,000	1,614,000	1,614,000	915,000	1,041,000	1,225,000
Annual Costs	514,000	577,000	731,000	846,000	1,354,000	1,305,000	1,264,000	1,367,000	700,000	722,000	860,000
Excess Benefits Over Costs	401,000	464,000	494,000	471,000	305,000	342,000	350,000	247,000	215,000	319,000	365,000
Benefit-to-Cost Ratios	1.8	1.7	1.7	1.6	1.2	1.3	1.3	1.2	1.3	1.4	1.4

*** Includes mitigation first costs.**



MAXIMIZATION OF NET BENEFITS – Aloha – Rigolette Area

FIGURE D-7



ALOHA-RIGOLETTE AREA, LOUISIANA STUDY
FEASIBILITY REPORT

STUDY AREA
HYDROLOGIC REACHES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
U.S. ARMY ENGINEER DISTRICT
LOWER MISSISSIPPI VALLEY
FILE NO.

PLATE D-1

APPENDIX E

DECEMBER 1982 POST FLOOD INVESTIGATION

ALOHA-RIGOLETTE AREA, LOUISIANA

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ALOHA-RIGOLETTE AREA, LOUISIANA

APPENDIX E

DECEMBER 1982 POST FLOOD INVESTIGATION

E.0.1. In late December 1982 and early January 1983, a severe storm blanketed central and south-central Louisiana. The Aloha-Rigolette area experienced widespread flooding and sustained nearly $3.0 million dollars in damages. Had this storm occurred during a more critical agricultural period, the damages would have been much greater. This appendix describes the extent of flooding in the basin and the damages sustained. This storm is important because it typifies the magnitude of areal flooding that occurs in the basin and the time it takes to evacuate the water from the basin.

SECTION 1. PURPOSE AND SCOPE

INTRODUCTION

E.1.1. During the last week in December 1982 and the first several weeks in January 1983, an intense storm blanketed Central and South-central Louisiana. The purpose of this report is to present data compiled on flooding that occurred in the Aloha-Rigolette area. Field investigations were made by survey teams from Gulf South Research Development Corporation (GSRDC) in the Aloha-Riglolette area. Within this area, two individual reaches were delineated for survey, Bayou Rigolette Reach and Bayou Du Grappe Reach.

E.1.2. GSRDC's survey team collected data by "visual survey" of the areas inundated and by personal interviews with state and local officials and selected private individuals. The information collected from the surveys is presented by reach in this report and pertains to the following categories:

- Residential flooding, both urban and rural, including number of acres and structures flooded.
- Values of structures flooded.
- Depth of flooding over the main floor.
- Types of structures flooded (one or two story, mobile homes, camps, etc.).
- Ability of residents to prevent or minimize damage (sandbagging, moving or elevating furniture, etc).,
- Nonresidential flooding, both urban and rural, including number of acres and structures flooded, according to type of business, estimated value of structures, depth of flooding over main floor.
- Agricultural flood damages, including total number of acres flooded and cleared acres flooded, with cleared acres flooded aggregated by specific crops of pasture; duration of flooding

(days); cost of re-establishing pasture, per acre; cattle handling costs including, where available, costs for relocation, supplemental pasture and feed, and re. ~ning cattle to original pasture.

- Determination of state, parish and municipal expenditures for manpower, materials, and related costs for road and bridge repairs, emergency operations, etc.
- Determination of the number of residents evacuated.
- Determination of other acreage flooded (marsh, woodland, etc.) by reach.
- Plotting of overflow map indicating the actual extent of flooding based on field data compiled.

SECTION 2. DESCRIPTION OF FLOOD

BACKGROUND INFORMATION

E.2.1. The initial flooding resulted from heavy rains that began to fall around Christmas Eve. In some areas, the rainfall continued into the week following Christmas, by which time as much as 20 inches of rain had accumulated in several parishes. (See Table E-2-1 and Figure E-1 for precipitation data.) As the rains continued, overburdened streams, canals, and drainage ditches were unable to drain adequately into the larger bayous and rivers that were themselves beginning to overflow their banks. Area residents were faced with serious backwater flooding threats. Many residents were successfully evacuated and many were able to minimize damages to their homes and belongings by sandbagging and moving or raising furniture and other valuables. As rivers crested and water levels began to slowly decrease, most evacuees were able to return home by the second week in January. However, residents of some areas were not able to return to their homes for several weeks.

E.2.2. As a result of the extensive damages from the flooding, Governor Treen declared several parishes disaster areas and formally requested Federal aid from President Reagan for residents of these parishes. Two parishes within the Aloha-Rigolette study area, Grant and Rapides, were declared eligible for Federal relief.

TABLE E-2-1

DAILY PRECIPITATION
(Inches)

STATIONS	TOTAL	December 1982 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Winnfield 2 W	23.08	1.97		.16	.88	.17						1.09	.69			1.11
Gorum Fire Tower	21.36	2.55		1.85	.12						.11	1.50	.10			.84
Grand Ecore	20.55	1.67		1.34	2.42						.05	.74				1.32
Natchitoches	21.77	2.23		1.25	2.41	.02					.04	.83	.67			1.37
Alexandria	20.80	3.76	.01	.57	2.50	.12					.05	.74	.42			.74
Belah Fire Tower	25.45	3.34	.02	1.65	1.00	.15					.13	1.25	.48			.99
Boyce 3 WNW	17.32	.54		1.09	.09						.88	.92			1.08	.54

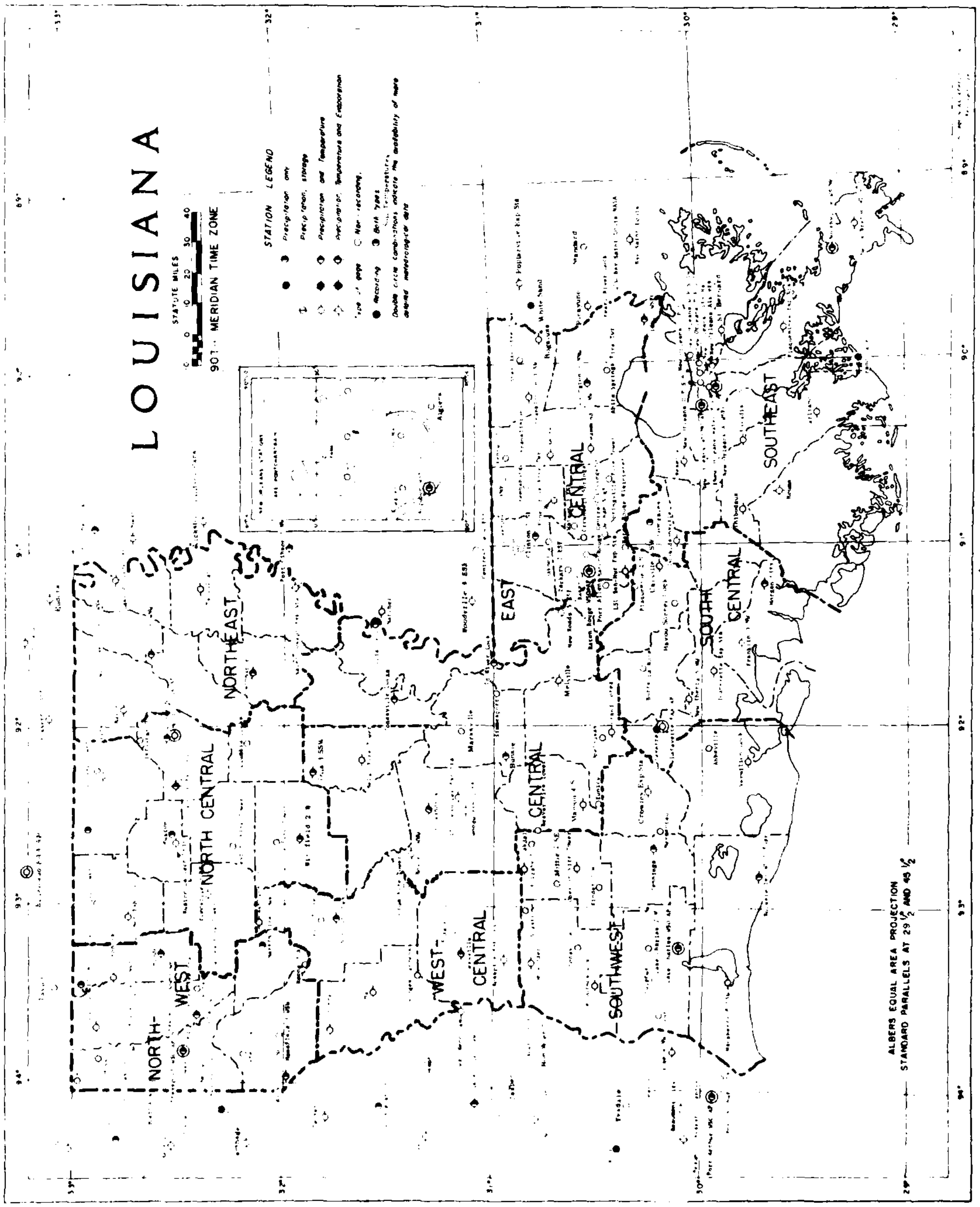
STATIONS	December 1982 (Continued) 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Winnfield 2 W	.01							.01		1.55	7.73	4.51	3.20			
Gorum Fire Tower							.35	.27		.35	8.40	4.80				.12
Grand Ecore										1.47	4.70	5.50	1.11			.23
Natchitoches	.02							.02		1.04	4.75	6.00	1.12			
Alexandria								.23	.02	.24	7.20	3.40	.80			
Belah Fire Tower							.04	.07	.05	1.10	11.50	3.30	.35			.04
Boyce 3 WNW	.02						.17	.02	.08	2.43	5.03	3.90		.01		.52

TABLE E-2-1 (CONTINUED)

DAILY PRECIPITATION
(Inches)

STATIONS	TOTAL	January 1983 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Winnfield 2 W	2.94	.21	.70						.41	.07						
Gorum Fire Tower	3.86	.80	.30						.35							
Grand Ecore	5.08		.46					.10	.12							
Natchitoches	2.10	.23	.53	.01					.07							
Alexandria	4.79	.62	.63						.48	.34						
Belah Fire Tower	5.25	.45	.80						.75	.20						
Boyce 3 WNW	5.45	.59						.29	.42	.01						

STATIONS	January 1983 (Continued) 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Winnfield 2 W			.07		.68	.27				.40		.09		.04		
Gorum Fire Tower				.06	1.25	.05				.35		.05		.65		
Grand Ecore			.07	.47	.20					.56						3.10
Natchitoches			.06		.54	.20				.46				.13		
Alexandria					1.41	.15	.01			.59		.01		.55		
Belah Fire Tower				.03	1.47	.05				.45		.30		.75		
Boyce 3 WNW				.35	1.05		.02		.58			.01		.03		2.10



SOURCE: National Oceanic and Atmospheric Administration

FIGURE E-1

SECTION 3. APPRAISAL OF DAMAGES

BAYOU RIGOLETTE REACH

GENERAL

E.3.1. Bayou Rigolette Reach is located in Grant Parish and in the northern part of Rapides Parish. It extends roughly from Pineville to a point just south of Colfax. The Red River levee forms the western boundary and a bluff (the 100-foot contour) forms the eastern boundary of this reach. Bayou Rigolette runs north-south through the entire reach. Bayous Darrow and Walden are the other major streams in this area.

E.3.2. Agricultural lands (such as soybeans, wheat, cotton, milo, and pasture), pine forests, and scattered narrow bands of bottomland hardwoods are included in the reach. It encompasses approximately 46,700 acres and is sparsely populated.

AREAS INUNDATED

E.3.3. The heavy rainfall within a short period of time partially obstructed bayous, and the inability of Bayou Rigolette floodgates to adequately release water from Bayou Rigolette and its tributaries caused extensive backwater flooding in this reach. Flooding was primarily along Bayous Rigolette, Darrow, and Walden. The Rigolette community, a rural community near Bayou Rigolette and the floodgates, was one of the areas flooded by backwater. Approximately seven residences in this area including four mobile homes were flooded. In addition, at least one farmer quickly built a levee around his house.

E.3.4. Although most of the homes flooded were in the southern part of the reach, flooding was widespread throughout the basin, covering

approximately 65 percent of the reach. Portions of several highways, U.S. 71, La. 492, and La. 8, were under water and part of Meade Road, which runs between Bayous Rigolette and Darrow and crosses Bayou Darrow, was under water for approximately one month. The extent of flooding is shown by land use categories in Table E-3-1.

TABLE E-3-1

ACRES FLOODED - BAYOU RIGOLETTE REACH

December 1982 Flooding

Land Use	Area Inundated (Acres)
Urban	
Residential	0
Commercial	0
Rural Developed	10
Agricultural 1/	26,600
Wooded	3,200
Other	0
TOTAL	30,810

1/ Includes 11,100 acres of fallow land.

ECONOMIC DAMAGES

E.3.5. Urban. There are no urban areas within Bayou Rigolette Reach; therefore, there were no urban damages.

3.6. Rural Developed. Rural developed areas are those containing various sparse improvements not considered urban. Small population centers, crossroads-type developments, scattered houses and businesses, miscellaneous farm structures, and pastures are included in this category. Approximately 10 acres of rural developed land were inundated. Within this area, seven structures including four mobile homes were flooded. Flooded damages were estimated to be $92,700 (see Table E-3-2).

E.3.7. Agricultural. Agricultural production sustained the greatest losses in this reach. Approximately 27,600 acres of agricultural lands including about 1,425 acres of beans (not harvested), 6,325 acres of wheat and 8,750 acres of native and improved pastures were inundated as a result of backwater flooding primarily from Bayous Rigolette, Darrow, and Walden. The winter wheat crop and the improved pasture received the most extensive damage with monetary losses of more than $717,000 and $690,000, respectively. Both improved and unimproved pastures were under water for varying periods of time. As a result, farmers had the expense of moving cattle to higher ground and providing supplemental feed. In addition, over 1,400 acres of beans that had not been harvested were lost and a few cattle and hogs were lost. Total agricultural damages for this reach were estimated to be approximately $1,925,600 (December 1982 prices).

E.3.8. Other. A government official estimated that about $92,500 damage was done to roads and bridges in the Grant Parish portion of Aloha-Rigolette area. Of this total, about three-fourths--$69,400-- occurred in the Bayou Rigolette Reach.

E.3.9. Grant Parish officials have no estimates available for the costs associated with evacuations, mass care, family assistance, utilities damage, or other flood-related activities or problems.

TABLE E-3-2

RURAL RESIDENTIAL STRUCTURES INDUNDATED

Bayou Rigolette Reach

Number of Stories	Type	Approximate Sq. Ft.	Approximate Value (Dollars)	Approximate Depth (Feet)	Approximate Duration (Days)	Approximate Damages Per Structure (Dollars)	Approximate Value of Contents Per Structure (Dollars)	Approximate Damages to Contents Per Structure (Dollars)	Number of Structures	Approximate Total Damages (Dollars)
1	Wood	1,500	32,086	0.5	2	6,135	19,684	2,264	2	16,798
1	Wood	2,700	59,050	0.5	2	11,042	35,430	4,074	1	15,116
1	Mobile Home	1,000	16,954	1.0	3	13,021	10,172	2,187	4	60,832
TOTAL									7	92,746
									(92,700 rounded)	

SUMMARY OF DAMAGES

E.3.10. Table E-3-3 gives a disaggreation of damages within Bayou Rigolette area.

BAYOU DU GRAPPE REACH

GENERAL

E.3.11. Bayou Du Grappe Reach is located in Grant Parish. It extends from the northern boundary of the Bayou Rigolette reach (roughly a line from McNeely north to Bayou Rigolette along the bluff) north to Highway 1240 along the south side of Natachie Lake. The Red River levee serves as the western boundary of this reach and the bluff (the 100-foot contour) and Iatt Lake Dam serve as the eastern boundary. The only urban area in this reach is the town of Colfax.

E.3.12. The major bayous in this small reach are Bayou Rigolette, which begins at Iatt Lake, Cornfeine Bayou, Bayou Du Grappe, and Sugarhouse Bayou. The reach encompasses approximately 14,000 acres and consists primarily of agricultural lands (such as soybeans, wheat, cotton, milo, and pasture) and pine forests.

AREAS INUNDATED

E.3.13. Heavy rainfall within a short period of time, partially obstructed bayous, and the inability of the Bayou Rigolette floodgates to release water from Bayou Rigolette and its tributaries caused water to back up and flood lands in this reach. The most serious flooding in the reach occurred in the area southwest of Iatt Lake Dam. Much of the land was still inundated at the time of this survey (March 1983). The eastern part of the town of Colfax was flooded as a result of backwater, primarily from Sugarhouse Bayou. Ten residential structures were reportedly inundated for two to three days. The extent of flooding is shown by land use category in Table E-3-4.

TABLE E-3-3

SUMMARY OF FLOOD DAMAGES

Bayou Rigolette Reach, December 1982 Flooding

Category	Damages
Urban	
Residential	$ 0
Commercial	0
Other	0
Rural Developed	92,700
Agricultural	1,925,000
Government	0
Transportation 1/	69,400
Utilities 2/	0
Miscellaneous	0
TOTAL	$2,087,700

1/ Damage to roads and bridges.

2/ Utilities report no significant damages.

TABLE E-3-4

ACRES FLOODED - BAYOU DU GRAPPE REACH

December 1982 Flooding

Land Use	Area Inundated (Acres)
Urban	
Residential	50
Commercial	0
Rural Developed	0
Agricultural 1/	9,100
Wooded	3,400
Other 2/	400
TOTAL	12,950

1/ Includes 6,600 acres of fallow land.

2/ Marsh.

ECONOMIC DAMAGES

E.3.14. Urban. Within the town of Colfax, nine houses and one mobile home were inundated for two or three days. Damages to these residences totaled approximately $123,700 (see Table E-3-5). No vehicles were reported damaged.

E.3.15. Rural Developed. There were no rural developed areas inundated in this reach.

TABLE E-3-5

URBAN RESIDENTIAL STRUCTURES INUNDATED

Bayou Du Grappe Reach

Number of Stories	Type	Approximate Sq. Ft.	Approximate Value (Dollars)	Approximate Depth (Feet)	Approximate Duration (Days)	Approximate Damages Per Structure (Dollars)	Value of Contents Per Structure (Dollars)	Damages to Contents Per Structure (Dollars)	Number of Structures	Approximate Total Damages (Dollars)
1	Brick	1,500	42,865	0.5	2	8,016	25,719	2,958	1	10,974
1	Brick	1,700	48,580	0.5	3	9,084	29,148	3,352	5	62,180
1	Brick	2,300	65,726	0.5	3	12,291	39,436	4,535	1	16,826
1	Wood/Brick	1,000	25,224	0.5	2	4,717	15,134	1,740	1	6,457
1	Wood/Brick	1,750	46,967	0.5	2	8,783	28,180	3,241	1	12,024
1	Mobile Home	1,000	16,954	1.0	3	13,021	10,172	2,187	1	15,208
TOTAL									10	123,669

E.3.16. Agricultural. Agricultural production sustained the greatest losses in the Bayou Du Grappe reach. Over 2,500 acres of wheat, improved pastures, and beans (not harvested) were inundated as a result of backwater flooding from Bayou Rigolette, Bayou Darrow, and Walden Bayou. The winter wheat crop and the improved pasture received the most extensive damage with monetary losses of approximately $99,200 and $79,500 respectively. Both improved and unimproved pastures were flooded for varying periods of time and some of these pastures still under water at the time of the survey. Farmers had the expense of moving cattle to higher ground and providing for supplemental feed. In addition, approximately 400 acres of beans that had not been harvested were lost and a few hogs were lost. Total agricultural losses for this reach were estimated to be approximately $330,500.

E.3.17. Other. Government officials reported $92,500 in damages to roads and bridges in the Grant Parish portion of the Aloha-Rigolette area. Of this total, approximately $23,100 damage or one-fourth of the total occurred in the Bayou Du Grappe reach. No other government expenditures or flood-related damages were reported.

SUMMARY OF DAMAGES

E.3.18. Table E-3-6 gives a disaggregation of damages within Bayou Du Grappe reach.

SUMMARY OF PHYSICAL AND ECONOMIC DAMAGES

E.3.19. Total acres flooded in the Aloha-Rigolette area are shown in Table E-3-7 by land-use category. Of the estimated 43,760 acres flooded, 84% was agricultural lands, 15% was wooded areas, and 1% was marsh. Urban and rural developed areas made up less than one percent of the total acreage.

TABLE E-3-6

SUMMARY OF FLOOD DAMAGES

Bayou Du Grappe Reach, December 1982 Flooding

Category	Damages
Urban	
Residential	$123,700
Commercial	0
Other	0
Rural Developed	0
Agricultural	330,500
Government	0
Transportation 1/	23,100
Utilities 2/	0
Miscellaneous	0
TOTAL	$447,300

1/ Damage to roads and bridges.

2/ Utilities report no significant damages.

TABLE E-3-7

SUMMARY OF AREA INUNDATED, BY REACH

Aloha-Rigolette Area - December 1982 Flooding

Reach	Urban (Acres)	Developed (Acres)	Agricultural (Acres)	Wooded (Acres)	Other (Acres)	Total (Acres)
Bayou Rigolette	0	10	27,600	3,200	0	30,810
Bayou Du Grappe	50	0	9,100	3,400	400	12,050
TOTAL	50	10	36,700	6,600	400	43,760

TABLE E-3-8

SUMMARY OF TOTAL ESTIMATED DAMAGES BY REACH

Aloha-Rigolette Area - December 1982 Flooding

Reach Losses	Residential	Commercial	Agricultural	Government	Transportation	Misc.	Total
Bayou Rigolette Reach	92,700	0	1,925,600	0	69,400	0	2,087,700
Bayou Du Grappe Reach	123,700	0	330,500	0	23,100	0	477,300
TOTAL	216,400	0	2,256,100	0	92,500	0	2,565,000

E.2.20. Total estimated economic damages in the Aloha-Rigolette area are shown in Table E-3-8. The estimated damages for the project area totaled $2,565,000.

E.3.21. The survey team made every effort to obtain either damage estimates or a basis for calculating damage estimates for all categories of flood damages for each reach or area surveyed. However, in categories such as cost to state and local government, utilities, and to, a lesser degree, costs for repairing roads and bridges, neither cost estimates or a basis for cost estimates could be obtained in all cases. Damage estimates included in this report were restricted to either quoted damages or damages that could be estimated with an acceptable degree of accuracy.

END

DATE
FILMED

12-85

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